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ICPP Tank Farm Closure Study

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PRIMARY TEAM MEMBERS

The following LMITCO personnel made significant contributions of their time and expertise to this study. Their work in reflected throughout this report and its appendices.

B. C. Spaulding	Technical lead, provided team direction, assumption and requirement development, drafted sections within the report, final report write-up.
R. A. Gavalya	Report information development, drafted sections within the report, assumption and requirement development, developed Environmental Impact Summary and Project Data Sheets, study of engineering issues, design concepts and calculations.
M. M. Dahlmeir	Total Removal Clean Closure Option development, assumption and requirement development, study of engineering issues, design concepts and calculations
L. C. Tuott	Regulatory Issue development, drafted sections within the report, assumption and requirement development, final report write-up.
K. D. McAllister	Report information development, drafted sections within the report, assumption and requirement development, study of engineering issues, design concepts and calculations.
K. C. DeCoria	Report information development, drafted sections within the report, assumption and requirement development, study of engineering issues, design concepts and calculations, developed Environmental Impact Summary and Project Data Sheets.
S. P. Swanson	Report information development, assumption and requirement development, study of engineering issues, design concepts and calculations.
R. D. Adams **F. P. Hanson**	Cost and schedule estimates.
G. C. McCoy	Radiological concerns and exposures, assumption and requirement development, drafted sections within the report.
R. J. Turk	Life cycle cost and yearly cash flow estimates.
W. T. Howard **Greg Housley**	Drafting Support

SUMMARY

Introduction

This study addresses closing 11 liquid waste storage tanks (300,000 – 318,000 gallons), tank vaults, and ancillary piping located within the Tank Farm Facility (TFF) of the Idaho Chemical Processing Plant (ICPP) and the subsequent use of the remaining tank voids. Descriptions and discussions of six options that could be used to achieve TFF Closure with subsequent use are also included in the study.

Background

In 1953, the ICPP located at the Idaho National Engineering and Environmental Laboratory (INEEL) was chartered to recover fissile uranium by reprocessing spent nuclear fuel. In April 1992, the United States Department of Energy (DOE) discontinued reprocessing spent nuclear fuel. The current mission for the ICPP includes management and storage of spent nuclear fuel, treatment and storage of high-level waste (HLW), and treatment and storage of low-level waste generated from past and present operations and activities. The TFF currently contains liquid waste inventories from past reprocessing operations and decontamination efforts.

A Notice of Noncompliance was issued by the Environmental Protection Agency in January 1990 because the 11 large liquid storage tanks do not meet the secondary containment requirements of the Resource Conservation and Recovery Act (RCRA). In addition, five of the tank vaults (WM-182 through WM-186) may not meet current structural seismic requirements. The Consent Order (3/30/92) that followed from the Notice of Noncompliance requires the INEEL to discontinue using five of the 300,000-gallon storage tanks (WM-182 through WM-186) and vaults by 3/31/09. The Consent Order also requires that the remaining six 300,000-gallon storage tanks (WM-180, WM-181, and WM-187 through WM-190) and vaults will be taken out of service by 6/30/15.

Tank Farm Facility Description

The TFF consists of underground storage tanks, tank vaults, interconnecting waste transfer lines, valve boxes, valves, airlift pit, cooling equipment, and several small buildings that contain instrumentation and valving for the waste tanks. The TFF tanks contain a liquid mixed (hazardous and radioactive) waste and are regulated as an interim status RCRA tank system for storage of this waste.

The eleven 300,000 to 318,000-gallon tanks (hereafter referred to as 300,000-gallon tanks) are contained in underground, unlined concrete vaults. The tanks have a 50 foot diameter with an overall height of approximately 30 feet (includes the dome height). Tanks WM-180 and WM-181 are bolted to the floor of their respective vaults. Tanks WM-182 through WM-190 rest on a thin

sand layer atop a concrete pad in the respective vault. The vault floor is approximately 45 feet belowgrade level.

The 300,000-gallon tanks are used to store mixed liquid wastes. The liquid wastes are acidic, ranging in molarity from 0.43 to 2.65 moles H^+/liter. Eight of the eleven 300,000-gallon tanks contain stainless steel cooling coils located on the tank walls and floors. These cooling coils were intermittently used to maintain the liquid waste below predetermined temperatures in order to minimize corrosion of the stainless steel tanks.

Each 300,000-gallon tank is enclosed in a concrete vault. The vaults are patterned after three basic designs. Tanks WM-180 and WM-181 are enclosed in cast-in-place octagonal vaults. Tanks WM-182 through WM-186 are contained in pillar-and-panel style octagonal vaults. The remaining tanks (WM-187 through WM-190) are enclosed in a cast-in-place square 4-pack configuration. To protect personnel from radiation, the concrete vault roofs are covered with approximately 10 feet of soil.

The individual vault designs differ in the ability to withstand seismic events. Studies were performed to determine if the vaults would meet seismic criteria established by the DOE. The cast-in-place octagonal vaults and the cast-in-place square 4-pack vaults met the seismic criteria whereas the pillar-and-panel vaults enclosing tanks WM-182 through WM-186 may not meet the seismic criteria. Since the pillar-and-panel vaults may not meet the seismic criteria, tanks WM-182 through WM-186 will be taken out of service before the other six tanks.

Liquid waste is transferred throughout the TFF in underground, stainless steel lines. The stainless steel lines are housed in stainless steel-lined concrete troughs or double-walled stainless steel pipe. Original stainless steel lines that were enclosed in split-tile have either been replaced or abandoned in place. The waste transfer lines are generally covered with 10 – 15 feet of soil. Liquid waste is routed through waste transfer valves located in underground, stainless steel-lined concrete boxes (referred to as valve boxes). The waste transfer valves are operated manually with reach rods or remotely with motor-operated valves.

Steam jets and airlifts placed inside the tanks are used for liquid waste transfers to other vessels. The steam jet and airlift intakes are located 4 to 12 inches above the tank floor, which limits the amount of liquid waste that can be removed from the tanks. The liquid waste that remains after the tanks have been emptied as low as possible with the steam jets and airlifts is referred to as a "heel." The heels will range in volume from 5,000 to 15,000 gallons.

Objectives

The purpose of this study was to identify and develop TFF Closure options that limit the risk to personnel and the environment, comply with federal and state regulatory requirements, are technically and economically feasible, and can be performed to meet predetermined schedules.

Principle objectives were to:

1. Define and describe activities required for TFF Closure when the tanks are taken out of service
2. Identify major regulatory, compliance, and design requirements for each closure option
3. Provide the closure option recommendations
4. Provide subsequent use recommendations for the tank voids after the tanks have been closed
5. Provide cost-bounding estimates for each closure/subsequent use option
6. Provide estimated schedules for each closure/subsequent use option.

RCRA Closure Methods

The TFF RCRA closure method will be conducted in accordance with a Closure Plan that has been reviewed and approved by the State of Idaho. RCRA closure of a tank system requires the removal or decontamination of all waste residues, structures and equipment contaminated with waste, and contaminated soils. If it can be demonstrated that it is not practical to remove all the waste or decontaminate all the system components as required, then the owner or operator must close the tank system to landfill standards and perform postclosure care of the system.

TFF Closure will be accomplished by either "Clean Closure" or closure as a "RCRA Landfill." It is assumed that any required final cover and long term monitoring will be provided by Comprehensive Environmental Response and Liability Act (CERCLA). This study evaluated two methods that would achieve clean closure for the TFF. The landfill method would close the TFF to landfill standards based on a demonstration that it is not practical to achieve clean closure. The methods of closure are:

1. Total Removal Clean Closure (TRCC) - total removal of the wastes, tanks, vaults, ancillary piping, and contaminated soils
2. Risk-Based Clean Closure (RBCC) - removal of sufficient wastes and contamination such that the remaining hazardous and radioactive constituents will not cause an unacceptable risk to the public
3. Closure to Landfill Standards – stabilization of wastes residues and providing for a landfill cap, monitoring, and long-term maintenance.

These RCRA closure methods close the tanks, vaults, and ancillary piping associated with the TFF. Each closure method fulfills the requirements identified for RCRA closure. Specifics on the closure methods are identified below.

Total Removal Clean Closure (TRCC) – Total removal of tanks, vaults, process piping, soils, and other contaminated components such that remaining contaminants are no longer detectable above background measurements within the TFF.

If the TRCC method is chosen, all waste and contaminated components within the TFF will be removed from the site for treatment and disposal at an onsite or offsite facility. If soil is contaminated with waste during cleanup, the contaminated soils will require removal and treatment. TRCC will require close coordination between RCRA and CERCLA since both have responsibilities for waste disposition within the TFF.

Risk-Based Clean Closure (RBCC) – Cleaning the tanks, vaults, and ancillary piping such that the remaining waste residues are at a low enough level that the risk to public health is within the risk assessment limits for the entire ICPP.

Using the RBCC method requires that TFF wastes be removed and associated components be decontaminated to a predetermined cleanliness level. This cleanliness level will be based on the risk of an additional cancer occurrence to the public occurring from the remaining TFF contaminants. This risk is expected to be in the range of 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000). The TFF risk value is a fraction of the total ICPP risk to the public value and must be consistent with the CERCLA program's cumulative risk assessment limits for the ICPP.

Closure to Landfill Standards (CLFS) – Stabilizing waste residues within the tanks, vaults, and ancillary piping with grout in order to minimize the release of contaminants into the environment. In addition, a monitoring system will be installed to detect contaminants that may have escaped. A cover will also be placed over the tank to prevent liquid from entering the landfill that could carry waste residues into the environment.

If it can be demonstrated that it is impractical or prohibitively expensive to remove all contaminants from the tanks, vaults, and piping, then the CLFS method will be used. Since some contaminants will remain in the TFF that could potentially leach or migrate into the groundwater, it will be necessary to install a groundwater monitoring system. To minimize the migration of liquids through the closed landfill, a final cover (or cap) will be installed over the entire TFF Area to prevent liquids from entering the landfill.

<u>Subsequent Tank Void Uses</u>

If the TFF is closed through either the RBCC process or the CLFS process, most of the void space within the underground tanks will be left unfilled. To prevent future subsidence of overburden above the empty tanks, the tank voids could be filled with the following materials:

LLW Grout – Grout that contains low-level waste (LLW) with a Nuclear Regulatory Commission (NRC) "Class C" classification. The LLW will be produced in an onsite grout plant at ICPP.

CERCLA Waste – Contaminated soils that are the responsibility of the CERCLA program.

Clean Fill – Material such as sand, gravel, or grout that contains no radioactive or hazardous wastes.

Filling the tank voids with LLW grout will require creation of an LLW landfill that is approved by the NRC. Using the empty tanks as a landfill for LLW or CERCLA waste produced at the INEEL would eliminate the need to treat, transport, and dispose of these wastes at other onsite or offsite facilities. Filling the tanks with either of the three materials will also prevent future subsidence problems after the TFF has been closed.

TFF Closure and Subsequent Use Options

Six TFF Closure options were developed by combining the three RCRA Closure paths with the three subsequent use alternatives identified earlier. The six options identified are:

1. Total Removal Clean Closure
2. Risk-Based Clean Closure; tank voids subsequently used as an LLW Landfill
3. Risk-Based Clean Closure; tank voids subsequently used as a CERCLA Waste Landfill
4. Close to Landfill Standards; tank voids subsequently used as an LLW Landfill
5. Close to Landfill Standards; tank voids subsequently used as a CERCLA Waste Landfill
6. Close to RCRA Landfill Standards; tank voids filled with clean fill.

Applicable radiation protection and controls will be instituted for all six options to minimize worker exposure and radioactive releases to the environment. Worker exposures will be kept "As Low As Reasonably Achievable" (ALARA) through administrative controls, engineered barriers, and remote handling of contaminated equipment where possible.

NOTE: Various methods and scenarios were developed in this study to support the six closure and subsequent use options (Options 1 through 6) presented in this report. The engineering team, consisting of Lockheed Martin Idaho Technologies Company (LMITCO) personnel, developed the various methods, scenarios, and options presented. This study does not, however, select a preferred or recommended closure and subsequent use option.

Table ES-1 shows the closure and subsequent tank void use options identified by this study and the main actions conducted during closure and subsequent use operations. The closure and subsequent use option numbers were selected based on regulatory path criteria and does not indicate the recommended closure path order.

Table ES-1 Closure and Subsequent Use Options[b]

Option	Name	CERCLA Action - Soil Removal	Tank and pipe isolation	Characterize Heel Contaminants	Complete System Removal	Iterative tank decontamination	Characterize Heel Contaminants for RA	Grout Heel	Iterative vault decontamination	Grout Vault	Achieve Risk Assessment (RA) Criteria	Tank Void - Class C Grout Fill	Transfer vacant tank void to CERCLA	Tank Void - CERCLA Fill	Tank Void - Clean Grout Fill	CERCLA Transfer–final cap & monitoring
1	Total Removal Clean Closure	X		X	X	X										
2[a]	Risk-Based Clean Closure; LLW fill		X	X		X	X	X[c]	X	X[c]	X	X				X
3[a]	Risk-Based Clean Closure; CERCLA fill		X	X		X	X	X[c]	X	X[c]	X		X	X		X
4	Close to RCRA Landfill Standards; LLW fill		X	X		X		X	X	X		X				X
5	Close to RCRA Landfill Standards; CERCLA fill		X	X		X		X	X	X			X	X		X
6	Close to RCRA Landfill Standards; Clean fill		X	X		X		X		X					X	X

a. Grouting the vault & tank heels and completing closure to landfill standards is the secondary path required for this option if the Risk-Based Closure criteria could not be met.
b. Clean fill material could be substituted for the fill material identified in Options 2 through 5. This study assumes that the tank voids for Options 2 through 5 would be filled with NRC Class C or CERCLA contaminated materials. If one or more of these options were implemented and then could not be accomplished, the tank voids could then be filled with clean material such as grout (Option 6) to accomplish RCRA closure to landfill standards.
c. Not required by regulation. Considered best management practice.

A brief description of the six options follows.

Option 1 - Total Removal Clean Closure

Total Removal Clean Closure (TRCC) requires complete removal of the tanks, vaults, piping, auxiliary equipment, and contaminated soil in the TFF. After closure is complete, all radioactive and hazardous waste will have been removed from the TFF. The RCRA program will be responsible for decontamination, removal, and disposal of the tanks, vaults, and ancillary piping. The CERCLA program will be responsible for removal and treatment of contaminated soils in the TFF.

Total removal tasks include:

1. Removal of as much of the tank contents as possible with existing waste transfer equipment

2. Removal of the remaining tank contents (referred to as a "heel")

3. Removal of all tanks, vaults, ancillary piping, contaminated soils, and auxiliary equipment associated with the TFF

4. Packaging and shipment of all waste items for disposal

5. Filling the excavated area with clean soil to grade level.

Radiation exposures are expected to be much higher for TRCC than in the other options since workers will be removing, handling, and processing contaminated components and soils.

The total estimated life-cycle escalated cost for TRCC is $5.33 billion. The RCRA program will be responsible for approximately $3.17 billion in costs while the CERCLA program costs will be about $2.16 billion. The activities for Option 1 are scheduled for 2003 – 2036.

Option 2 - Risk-Based Clean Closure, LLW Landfill

Risk-Based Clean Closure (RBCC) would be a less expensive alternative to TRCC since the structural components and ancillary piping will be decontaminated and left in place. Radiation exposure will be significantly lower since less handling of contaminated components and soils will occur.

In RBCC, the majority of radioactive and hazardous wastes will be removed during the waste removal and decontamination process. The remaining wastes in the TFF will be at a concentration that the risk to the public of an additional cancer occurrence meets the Closure Plan acceptance criteria. It is anticipated that the acceptance criteria will require that the risk of an additional cancer occurrence due to the remaining waste is in the range of 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000).

The tanks and vaults will be washed and rinsed to remove the majority of wastes and contaminants. The ancillary piping, such as waste transfer lines and cooling lines, will also be flushed and grouted. Tank leak monitoring lances will then be installed in four equally spaced locations inside the vaults. Afterwards, the vaults will be completely filled with clean grout to prevent the intrusion of liquid and to act as a temporary cover or cap over the tank. When pouring is complete, the 11 tanks, and the sand under nine of the 11 tanks, will be encapsulated between the newly poured grout and the vault floor.

After the TFF has been Risk-Based Clean Closed, the tank voids will be used as an LLW Landfill. The tank voids will be filled with LLW grout that is produced at an onsite grout plant and delivered to the TFF in shielded piping.

The grout will be distributed to the 11 tanks through a manifold system that branches out to each tank.

The risk-based tasks include:

1. Development of risk assessment criteria for the tanks, vaults, and ancillary piping
2. Heel characterization
3. Removal of the tank heel
4. Verifying compliance with risk assessment criteria
5. Characterizing vault contamination
6. Performing vault decontamination
7. Verifying compliance with risk assessment criteria
8. Closing tanks per risk assessment criteria
9. Minimizing free liquids in tank and vault.

The total estimated life-cycle escalated cost for Option 2 is $205.50 million. The activities for Option 2 are scheduled for 2000 – 2024.

Option 3 - Risk-Based Clean Closure, CERCLA Waste Landfill

Option 3 differs from Option 2 in that the tank voids will be filled with CERCLA waste rather than LLW grout. CERCLA waste will consist primarily of contaminated soils in the TFF and surrounding areas. The CERCLA waste will be mixed with paraffin based grout and subsequently pumped into the tanks.

As in Option 2, the tank system will be Risk-Based Clean Closed before CERCLA waste is placed in the tank voids.

The total estimated life-cycle escalated cost for Option 3 is $237.76 million. The activities for Option 3 are scheduled for 2000 – 2029.

Option 4 - Close to Landfill Standards, LLW Landfill

If it can be demonstrated that the TFF cannot be practically decontaminated at the time of closure, the tanks, vaults, and ancillary piping will be closed to RCRA Landfill Standards. The tank undergoing closure will be isolated from the other tanks by flushing and grouting or capping pipes routed to the tank. The tank will then be washed and rinsed to remove some contaminants. Approximately 12 inches of grout will be placed in the tank bottom to stabilize the heel. The remainder of the tank will be available for subsequent use as an LLW Landfill.

Groundwater monitoring probes will be placed in the vaults to detect any waste leakage of wastes from the closed tank. Afterwards, the vaults will be completely filled with clean grout to prevent liquid intrusion and to act as a temporary cover or cap over the tank. When pouring is complete, the tank will be encapsulated. At this point, the tank system will be considered RCRA closed. However, additional activities would need to be conducted to complete the project. These additional activities would be conducted under the auspices of other regulatory programs such as CERCLA or NRC as identified in the following discussion.

After the TFF has been RCRA closed, the tank voids will be filled with LLW grout. The LLW grout will be produced at an onsite grout plant and delivered to the TFF in shielded piping. The grout will be distributed to the 11 tanks through a manifold system that branches out to each tank. It is assumed that the NRC will oversee the LLW landfill operations.

When all of the tanks have been filled with LLW grout, the TFF will be turned over to the CERCLA program for installation of a final cover or cap, postclosure care, and long-term monitoring.

The total estimated life-cycle escalated cost for Option 4 is $185.48 million. The activities for Option 4 are scheduled for 2000 – 2024.

Option 5 - Close to Landfill Standards, CERCLA Waste Landfill

As in Option 4, the tanks, vaults, and ancillary piping will be closed as a RCRA landfill if it can be demonstrated that it would be impractical to decontaminate the TFF components to the extent that RBCC could be achieved. The steps to close the TFF to RCRA Landfill Standards are described in Option 4.

After the TFF has been closed to RCRA Landfill Standards, the tank voids will be filled with CERCLA waste. The CERCLA waste will be mixed with paraffin-based grout and pumped into the tank voids.

The CERCLA program will assume the responsibility for installation of a final cover or cap, postclosure care, and long-term monitoring.

The total estimated life-cycle escalated cost for Option 5 is $219.13 million. The activities for Option 5 are scheduled for 2000 – 2029.

Option 6 - Close to Landfill Standards, Clean Fill

As in Options 4 and 5, if it is determined that it would be impractical to remove or decontaminate all TFF components to the degree that clean closure could be achieved, the TFF will be closed to RCRA Landfill Standards. The same basic steps outlined in Option 4 will be used to achieve closure to RCRA Landfill Standards.

If it is determined that the tank voids cannot be used as a landfill for LLW or CERCLA waste, the tank voids will be filled with clean, uncontaminated fill material such as sand, gravel, or grout. Filling the voids with clean fill material will prevent future subsidence in the TFF. If clean grout is used to fill a tank void, the tank and its associated vault will be filled simultaneously to allow uniform grout lifts during the filling process.

A groundwater monitoring system will be installed to detect any contaminants that might escape the closed tank system. After the tank and vault voids are filled, the CERCLA program will place a final cover over the entire TFF. The CERCLA program will also assume responsibility for long-term monitoring and maintenance.

The total estimated life-cycle escalated cost for Option 6 is $134.93 million. The activities for Option 6 are scheduled for 2000 – 2021.

A flow diagram depicting TFF Closure activities is shown in Figure ES-1. The flow diagram shows the steps required for TRCC, RBCC, CLFS, and the subsequent use options. A more detailed flow diagram (4 sheets) is contained in the back of this report volume.

Regulatory Analysis

Regulatory requirements applying to TFF Closure will be followed to ensure that the closed TFF will not impose future threats to human health or the environment. The TFF must be closed in a manner that minimizes the need for future maintenance. It should also be closed in such a manner that the escape of hazardous wastes into the environment is eliminated or minimized.

Closure plans that explain in detail how the TFF will be closed and how the closure requirements will be met must be developed and submitted to the State of Idaho for review and approval. Once approved, all closure activities will be conducted in accordance with this approved plan.

Potential permits and approvals required for TFF Closure are listed and discussed in Section 4 of the main text. Principal laws and orders that will require permits and approval are:

1. Atomic Energy Act and Energy Reorganization Act

2. Clean Air Act and National Emission Standards for Hazardous Air Pollutants (NESHAPS)

3. Hazardous Waste Management Act

4. NRC Licensing as Near-Surface Disposal Area (applies if tanks voids are subsequently used as an LLW landfill)

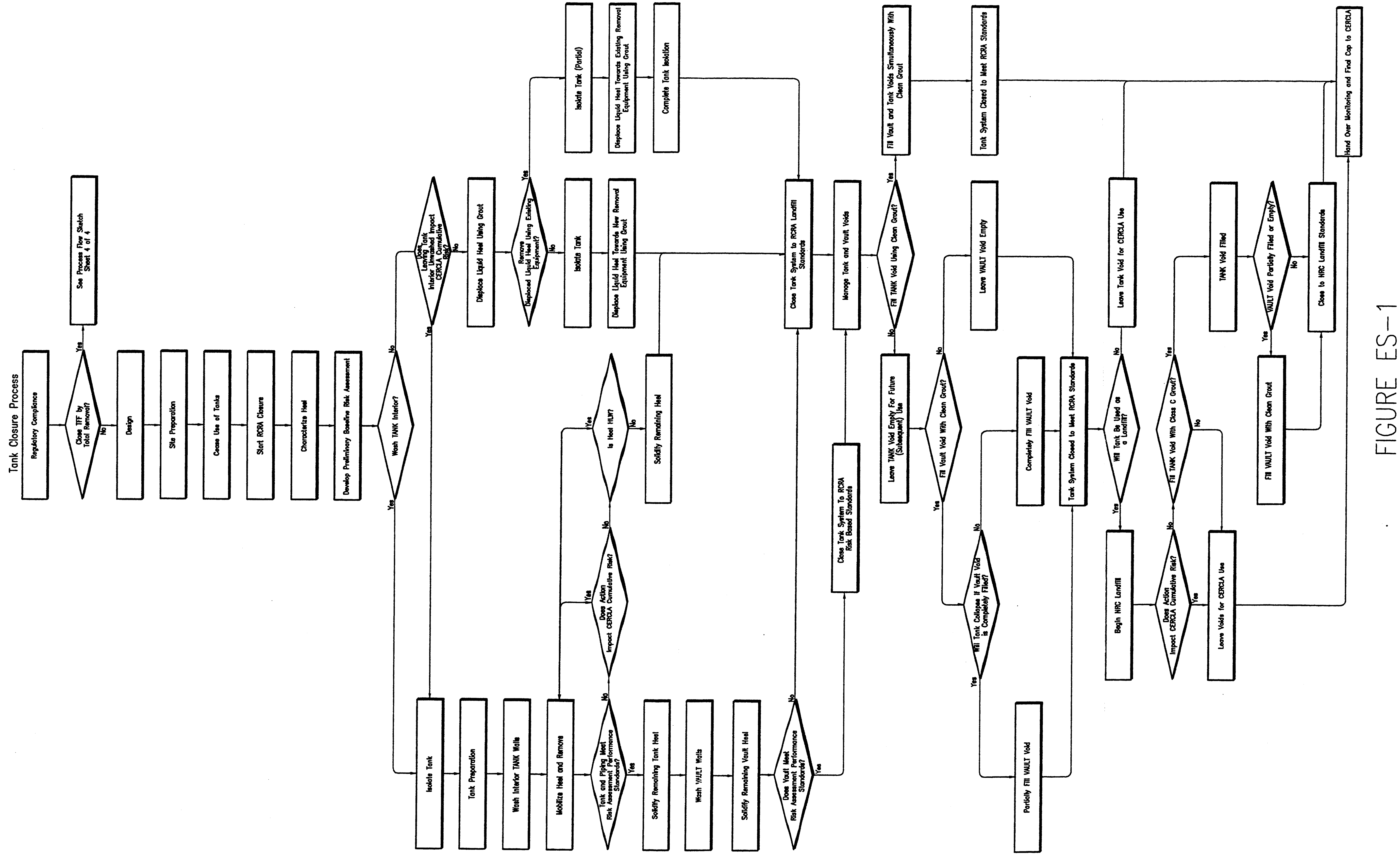

Figure ES-1. Process Flow Diagram.

9. Federal Facility Agreement/Consent Order

10. Consent Order of 3/30/92.

Several regulatory issues and concerns have been identified in regard to closure of the TFF. The primary areas of concern are:

Floodplain Status – 10 CFR 61.50(a)5 states that "waste disposal shall not take place in a 100-year floodplain, coastal high-hazard area or wetland, ..." Final floodplain maps for 100- and 500-year floods at the INEEL have not been developed at this time. At issue is whether the TFF lies within the 100-year floodplain and if so, the impact that a flood would have on the site.

Engineered and Maintained Flood Barriers – A diversion and dike system located near the Radioactive Waste Management Complex (RWMC) has been engineered to mitigate flooding at the INEEL. At issue is whether or not an engineered barrier would be acceptable as a means to prevent the impact of future 100- and 500-year floods if the TFF is considered to lie within a 100-year floodplain.

Key Requirements and Assumptions

A requirements and assumptions section was developed to establish the design bases for the TFF Closure options. Key requirements and assumptions are listed below.

1. The NRC Class C grout placed in the TFF shall be a radioactive, nonhazardous waste.

2. DOE shall treat all HLW currently at the INEEL so that it is ready to be moved out of Idaho for disposal by a target date of 2035.

3. The State of Idaho will accept closure to RBCC standards or, if demonstrated to be impractical, will accept CLFS.

4. Responsibility for capping, monitoring, and long-term maintenance will be transferred to the CERCLA program.

Changes in the above key requirements and assumptions could impact costs, schedules, and the method used to achieve closure.

Summary

All three of the RCRA Closure Paths identified in the study (TRCC, RBCC and, CLFS) are technically feasible given the necessary time and resources. However, closing the TFF by TRCC is not recommended due to the high worker radiation exposures that would result from this method.

Clean closure should be attempted using a risk-based approach. A risk assessment would be prepared to determine the risk to human health and the environment from leaving contaminants in place. Following decontamination, it would be necessary to demonstrate that the levels of remaining hazardous contaminants do not exceed the risk-based performance standard.

If the level of remaining hazardous contaminants still exceeds the risk-based performance standards after several iterative decontamination efforts and data trends indicate that further decontamination efforts will not reduce contamination levels sufficiently to meet the risk-based performance standards, the TFF should be closed to RCRA landfill standards. Following closure, the tank voids would be available for final disposal of LLW grout, CERCLA waste, or clean fill material.

Future Studies

Before initiating any of the RCRA Closure Paths, the following studies should be conducted:

1. Tank Heel Characterization – Conduct heel characterization sampling that provides accurate physical and chemical data on each tank. This includes characterization of the nonsodium bearing waste heel. The concentrations identified by this characterization will dictate the degree of decontamination required to meet the incidental waste criteria.

2. Schedule Conflicts – Scheduling conflicts between projects in regard to Class C grout production through disposal.

3. Thermal Analysis – A thermal analysis for each tank determining the maximum grout amount that can be poured at one time.

4. NRC Licensing – The impact that NRC licensing could have on TFF Closure activities and its subsequent use as a LLW landfill are unknown at this time.

5. Grout Characteristics – Experiments to determine the heel solidification and tank void filling grout characteristics should be conducted. This would include compressive strength and leachability experiments.

6. Closure of the 18,400 and 30,000-Gallon Tanks – Conduct a study to establish the closure criteria, schedule, and cost estimate for closure of these tanks.

7. Incidental Waste Determination – Compliance associated with the incidental waste determination requires additional analysis.

Uncertainties

There are numerous uncertainties concerning closure of the TFF that must be addressed before initiating closure activities. These uncertainties include:

1. Acceptable Risk and Contaminant Levels – The acceptable risk and contaminant levels for the TFF.

2. CERCLA Cumulative Risk Levels – The CERCLA cumulative risk levels for the ICPP and that portion of this CERCLA cumulative risk that will be allotted to the TFF.

3. NRC Class C Waste – NRC Class C Waste issues such as the amount and rate of Class C grout that will be produced during a grouting campaign.

4. Residue Determination - Guidance associated with HLW and incidental waste is vague or undefined.

5. Previous DOE Decisions on Grout Stability – DOE has modified the strategy for using grout to stabilize waste at other DOE Sites based on public input.

6. Defense of CLFS Removal Standards – Demonstrating the point at which it would be impractical to remove additional contaminants.

7. Class C Limits of Tank Residue – Models and parameters need to be reviewed to determine if Class C parameters are achievable.

8. TRU Waste Limits – If the sum of TRU radionuclides, set by a site-specific Class C limit, exceed 100 nCi/g, the waste might be classified as TRU waste.

9. Degree of Waste Removal Required for Closure – Currently no agreement exists between DOE-ID and the State of Idaho as to the degree of waste removal (or acceptable risk) that should be used for the development of waste retrieval systems technology, retrieval systems engineering, and the point where retrieval operations are complete.

10. Floodplain Study – The INEEL floodplain study has not been finalized and could impact options associated with the use of the tank void for the placement of a Class C grout.

11. HLW or Incidental Waste Determination – The "Incidental Waste Determination" methodology has not been applied to the TFF tanks. Therefore, its acceptance by the NRC is unknown. This is due to the uncertainties in the interpretation of the incidental waste definition, unique waste at the INEEL, and the evolving regulatory direction being provided by the NRC.

12. Exemption from Nuclear Waste Policy Act (NWPA) – A repository for HLW that is used only for atomic energy defense activity is exempt from the requirements of the NWPA [NWPA Section 8(b)]. This exemption should be further researched to identify possible alternative paths for the management of HLW in tanks.

13. Clean Closure Performance Standards - The Idaho Hazardous Waste Permitting Bureau (HWPB) has verbally identified a potential issue concerning performance standards for residue remaining in a system even though "clean closure" performance standards are achieved. The HWPB, however, has not provided guidance concerning acceptable performance standards for this residue. These performance standards may affect the proposed closure methods.

14. Separate CERCLA RI/FS – A CERCLA Remedial Investigation and Feasibility Study (RI/FS) will be performed for the releases associated with the TFF. The outcome of this study is unknown at this time and could impact assumptions associated with the placement of a landfill cap over the TFF by the CERCLA program.

15. Heel Characteristics – Existing heel characterization information is outdated and was not conducted on each tank. Accurate heel characterization information could impact the identified closure methods.

16. Schedule for Closure of the 18,400 and 30,000-Gallon Tanks – The date for submittal of a Closure Plan to the State of Idaho and the subsequent closure of the 18,400 and 30,000-gallon tanks has not been identified. While the closure of these tanks is outside the scope of this study, this could impact the TFF Closure cost and schedule.

After the above studies and uncertainties have been resolved, a TFF Closure and Subsequent Use Option can be determined that meets the applicable regulatory requirements and is technically and economically feasible.

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ACRONYMS

AEA	Atomic Energy Act
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
APAD	air permit applicability determination
APM	automated personnel monitor
APS	Atmospheric Protection System
ARM	area radiation monitor
ATC	application to construct
BDAT	best demonstrated available technology
CAA	Clean Air Act
CAM	constant air monitor
CBI	Chicago Bridge and Iron
CCD	charged coupled device
CCU	Contamination Control Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFC	chlorofluorocarbon
cfm	cubic feet per minute
CFR	Code of Federal Regulation
CLFS	Closure to RCRA Landfill Standards
CLSM	controlled low-strength material
CO	Consent Order
CSSF	Calcined Solids Storage Facility
D&D	decontamination and decommissioning

DEQ	Department of Environmental Quality
DET	determination of equivalent treatment
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
DOI	Department of the Interior
DOT	Department of Transportation
DTF	Debris Treatment Facility
EA	Environmental Assessment
ECA	Environmentally Controlled Area
EDE	effective dose equivalent
EDF	Engineering Design File
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FAST	Fluorinel Dissolution Process and Fuel Storage
FEA	Federal Energy Administration
FFA	Federal Facility Agreement
FPC	Federal Power Commission
G&A	General and Administrative
gpm	gallons per minute
HAW	high activity waste
HEPA	high-efficiency particulate air
HLW	high-level waste
HLWT	High-Level Waste Treatment
HWMA	Hazardous Waste Management Act of 1983

HWMA	Hazardous Waste Management Act of 1983
HWPB	Hazardous Waste Permitting Bureau
ICPP	Idaho Chemical Processing Plant
IDAPA	Idaho Administrative Procedure Act
IDHW	Idaho Department of Health and Welfare
IHWMA	Idaho Hazardous Waste Management Act of 1983
INEEL	Idaho National Engineering and Environmental Laboratory
IPR	Initial Phase Remedy
IRC	INEEL Radiological Control Manual
ISFSI	Independent Spent Fuel Storage Installation
LAC	Large Area Containment
LCC	life-cycle cost
LDR	Land Disposal Restriction
LDUA	light duty utility arm
LLW	low-level waste
LMITCO	Lockheed Martin Idaho Technologies Company
lpm	liters per minute
LTS	Liquid Transfer Sheet
MEI	maximally exposed individual
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NON	Notice of Noncompliance
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System

NRC	Nuclear Regulatory Commission
NWCF	New Waste Calcining Facility
ODC	Other Direct Costs
OMB	Office of Management and Budget
ORR	Operational Readiness Review
OSHA	Occupational Safety and Health Administration
P&ID	piping and instrumentation drawing
PCB	polychlorinated biphenyl
PEWE	Process Equipment Waste Evaporator
PIF	Performance Incentive Fee
PMF	probable maximum flood
PMP	probable maximum precipitation
PPE	personal protective equipment
PTC	permit to construct
QTP	Qualification Test Procedure
RA	remedial assessment
RAL	Remote Analytical Laboratory
RBCC	Risk-Based Clean Closure
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RI/FS	Remedial Investigation and Feasibility Study
RD	remedial design
ROD	Record of Decision
RRWAC	Reusable Property, Recyclable Materials, and Waste Acceptance Criteria
RWMC	Radioactive Waste Management Complex

SBW	sodium-bearing waste
SDA	Subsurface Disposal Area
SNF	spent nuclear fuel
SCOHP	Subcontract Overhead and Profit
STP	Site Treatment Plan
SWPP	service waste percolation pond
SWPPP	Stormwater Pollution Prevention Plan
TCLP	toxicity characterization leaching procedure
TFF	Tank Farm Facility
TRCC	Total Removal Clean Closure
TSA-RE	Transuranic Storage Area-Retrieval Enclosure
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
VE	Value Engineering
VOC	volatile organic compound
VOG	vessel off-gas
WAG	waste area group
WCF	Waste Calcining Facility
WPCS	Waste Processing Computer System

ICPP Tank Farm Closure Study

1. INTRODUCTION

In 1953, the Idaho Chemical Processing Plant (ICPP) located at the Idaho National Engineering and Environmental Laboratory (INEEL) (see Figure 1-1) was chartered to recover fissile uranium by reprocessing spent nuclear fuel (SNF). With the diminishing need to recover and recycle this material, the United States Department of Energy (DOE) discontinued reprocessing SNF in April 1992. This shifted the ICPP focus toward continued management and disposition of waste accumulated from previous reprocessing activities. The current DOE mission for the ICPP includes management and storage of the SNF, treatment and storage of the high-level waste (HLW) generated during past SNF reprocessing, and low-level waste (LLW) generated from other ongoing and future operations and activities.

The disposition of INEEL radioactive wastes is now under a "Settlement Agreement" (or "Batt Agreement") between the DOE and the State of Idaho. The Settlement Agreement requires that existing liquid sodium bearing waste (SBW), and other liquid waste inventories be treated by December 31, 2012. This agreement also requires that all HLW, including calcined waste, be disposed or made road ready to ship from the INEEL by 2035. Sodium bearing waste (SBW) is produced from decontamination operations and HLW from reprocessing of SNF. SBW and HLW are radioactive and hazardous mixed waste; the radioactive constituents are regulated by DOE and the hazardous constituents are regulated by the Resource Conservation and Recovery Act (RCRA). Calcined waste, a dry granular material, is produced in the New Waste Calcining Facility (NWCF).

Two primary waste tank storage locations exist at the ICPP (see Figure 1-2): Tank Farm Facility (TFF) and the Calcined Solids Storage Facility (CSSF). The TFF has the following underground storage tanks:

1. Four 18,400-gallon tanks (WM 100-102, WL 101)

2. Four 30,000-gallon tanks (WM 103–106)

3. Eleven 300,000+ gallon tanks. This includes nine 300,000-gallon tanks (WM 182–190) and two (2) 318,000 gallon tanks (WM 180-181).

This study analyzes the closure and subsequent use of the eleven 300,000+ gallon tanks, hereafter referred to as the 300,000-gallon tanks (see Figure 1-3). The 18,400 and 30,000-gallon tanks were not included in the work scope and will be closed as a separate activity (see assumptions Section 5.2.2, Future Studies, Section 12.1.6, and Uncertainties, Section 12.2.16).

This study was conducted to support the HLW Environmental Impact Statement (EIS) waste separations options and addresses closure of the 300,000-gallon liquid waste storage tanks and subsequent tank void uses. Figure 1-4 provides a diagram estimating how the TFF could be used as part of the separations options. Other possible TFF uses are also discussed in this study.

Hazardous waste management facilities such as the TFF must eventually cease treatment, storage, or disposal activities. When facilities cease use, the facilities must be maintained in a way that ensures they do not pose a future threat to human health or the environment. Cease use for the TFF is defined as

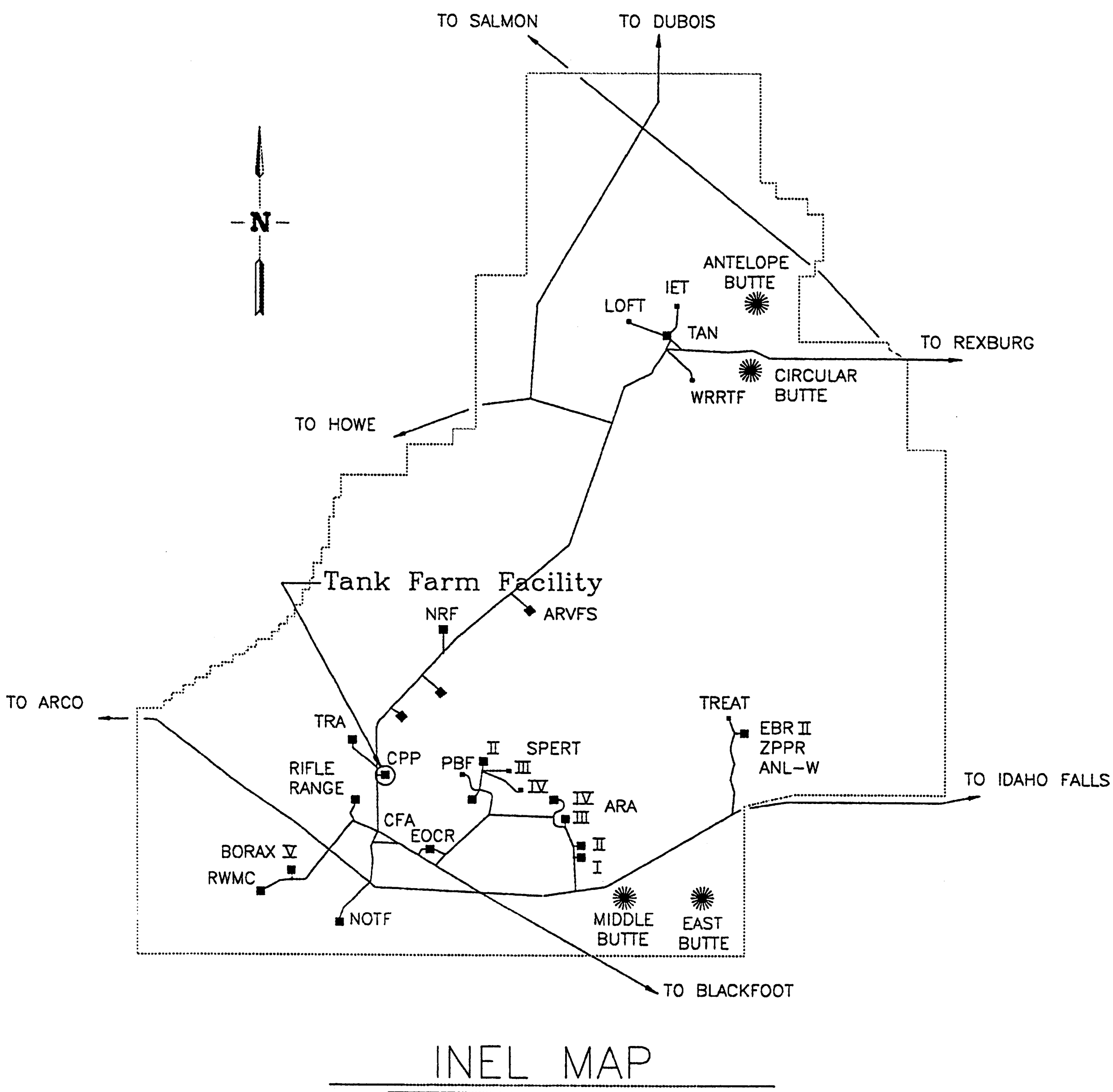


Figure 1-1. INEL Map.

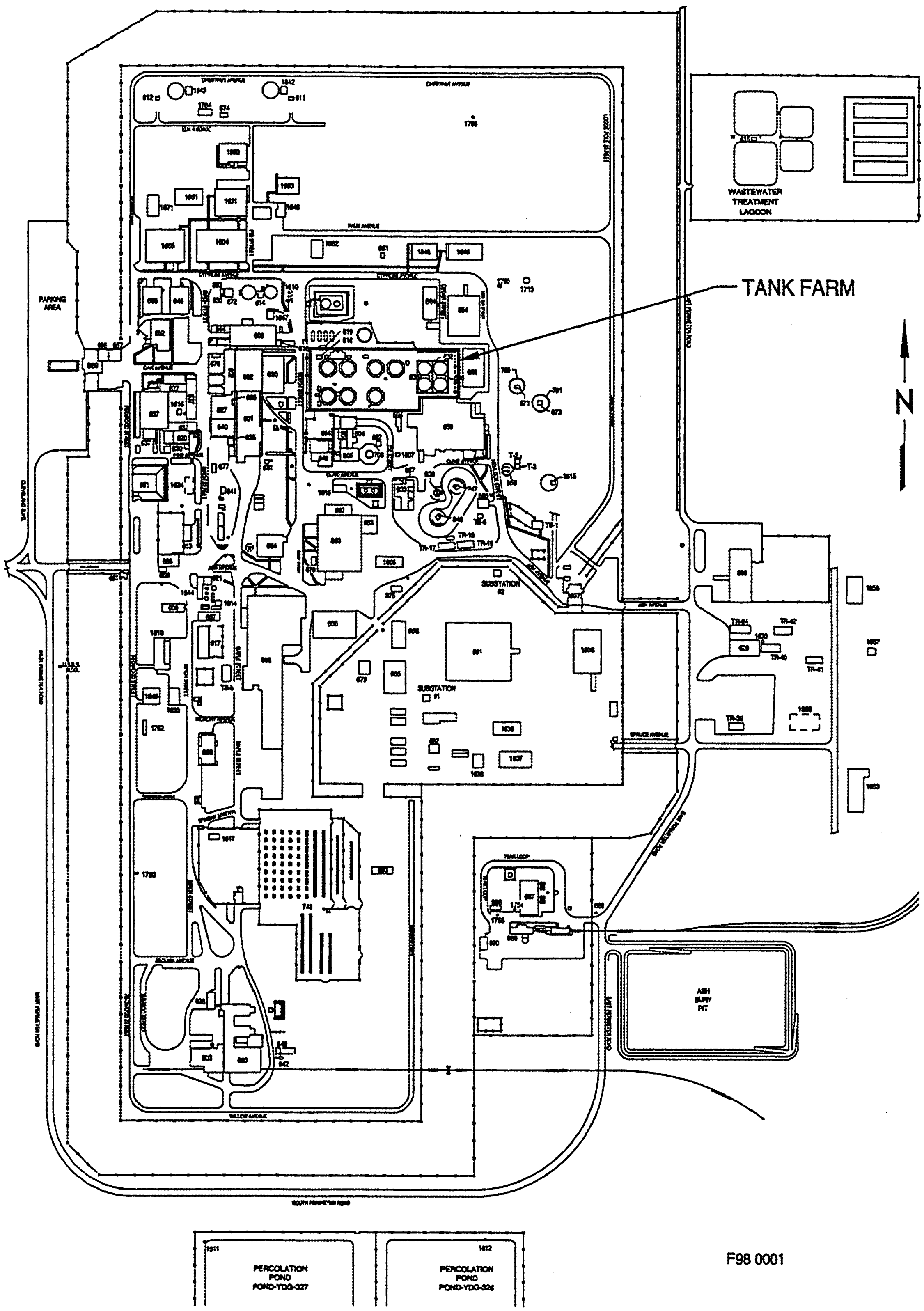


Figure 1-2. Idaho Chemical Processing Plant.

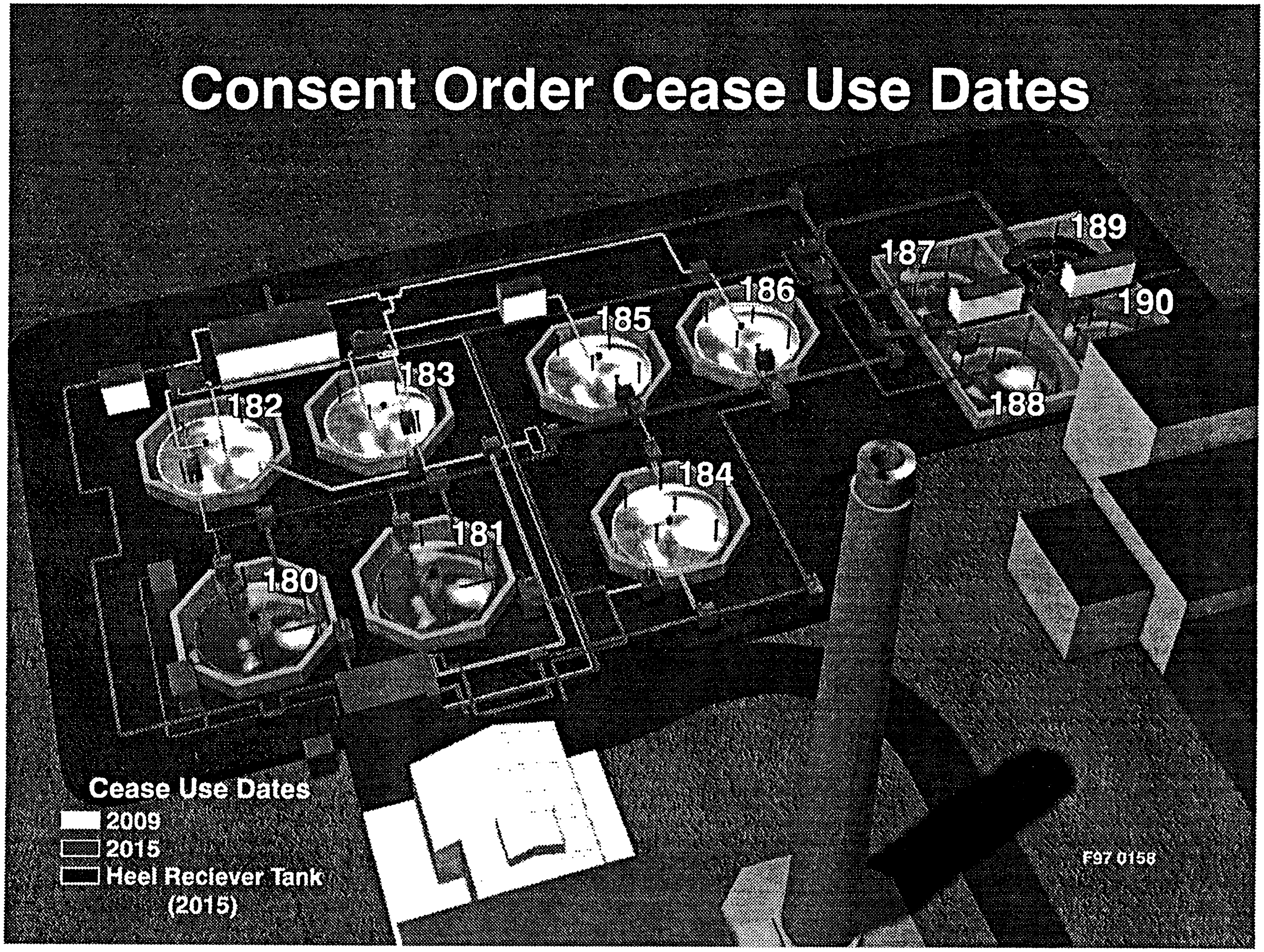
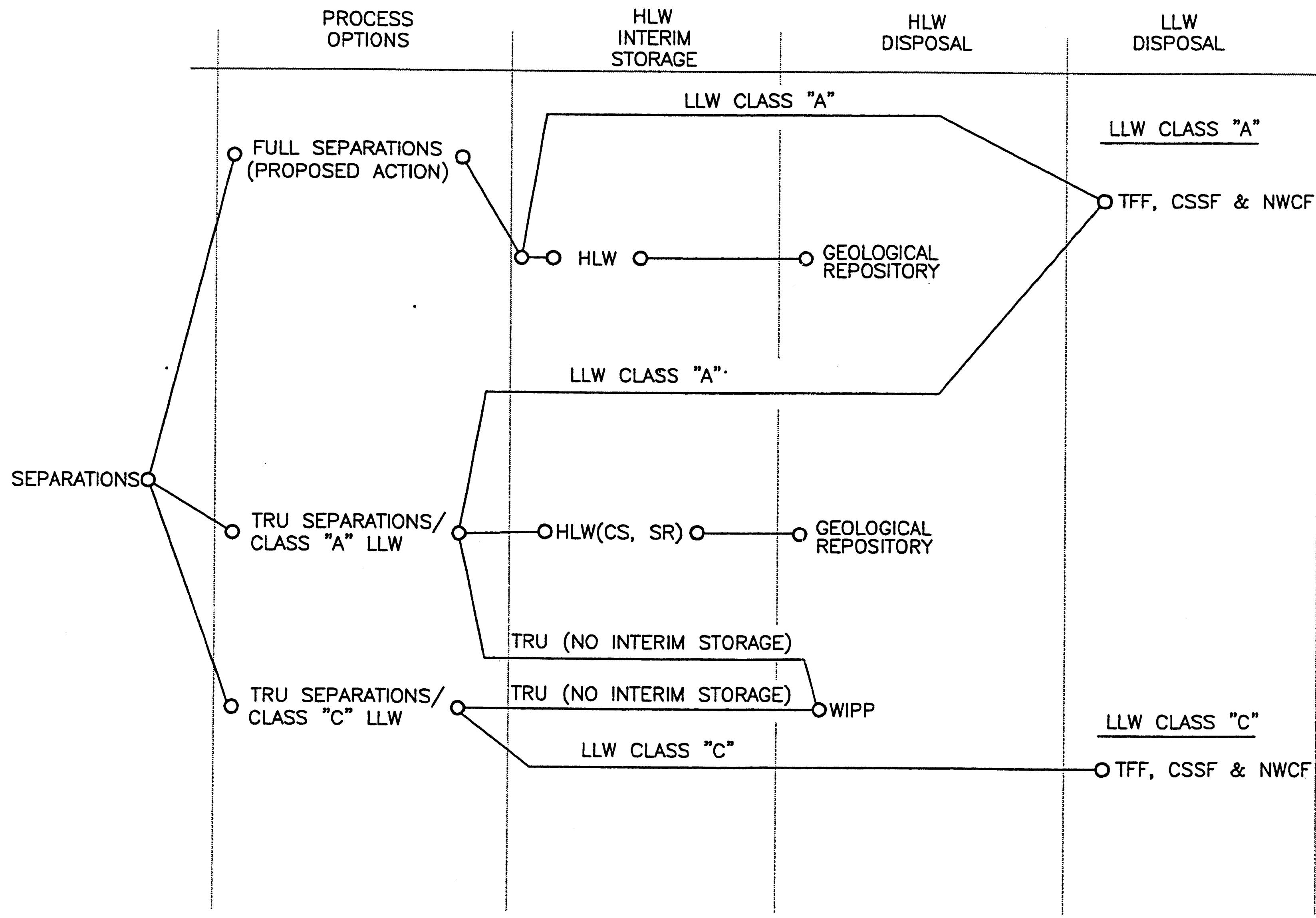


Figure 1-3. Tank Farm Facility.

LLW DISPOSAL IN TFF, CSSF & NWCF FOR SEPARATIONS OPTIONS
FIGURE 1-4



LEGEND:

CSSF.....CALCINE SOLIDS STORAGE FACILITY
HLW........HIGH LEVEL WASTE
LLW........LOW LEVEL WASTE
SR..........STRONTIUM
TFF.........TANK FARM FACILITY
TRU........TRANSURANIC
NWCF......NEW WASTE CALCINING FACILITY
CS..........CESIUM
WIPP.......WASTE ISOLATION PILOT PLANT

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY

HEEL DISPLACEMENT

SIZE D CAGE CODE 01MF3

SCALE: NONE SHEET 1 OF 1

File: FIGURE1-4.dwg Path: E:\wth\TB-1525 User: WTH Date: 01/07/98 - 2:34 P.M.

"lowering the liquid level of the tank to the greatest extent possible using existing tank transfer equipment.[1-1] The Consent Order (3/30/92) generated by the January 29, 1990, Notice of Noncompliance (NON), issued by the Environmental Protection Agency (EPA), requires the INEEL to cease use of five of the 300,000-gallon storage tanks (WM-182 through WM-186) and vaults by 3/31/09. (See Figure 1-3). The Consent Order also requires cease use of the other 300,000-gallon storage tanks (WM-180, WM-181, and WM-187 through WM-190) and vaults by 6/30/15. The NON was issued because none of the 300,000-gallon tank vaults met the secondary containment requirements of Resource Conservation and Recovery Act (RCRA). In addition, five of the tank vaults (WM-182 through WM-186) may not meet current structural (seismic) requirements.

Laws governing hazardous waste management, specifically the Idaho Hazardous Waste Management Act of 1983 (IHWMA) and RCRA are designed to ensure that facilities such as the TFF do not pose a future threat to human health or the environment. This goal is achieved through a process called *closure*.

Closure is the period following active management during which hazardous wastes are no longer accepted at treatment, storage, and disposal facilities (TSDFs) such as the TFF. The Consent Order requires cease use of the TFF (a storage facility), which then invokes TFF Closure. Closure requires the INEEL to complete storage operations at the TFF, remove all waste and waste residue, and dispose of or decontaminate equipment, structures, and soils associated with the TFF. Previously contaminated soils have been designated in the Federal Facility Agreement/Consent Order (FFA/CO) to be remediated through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. Soils contaminated during TFF Closure activities will be cleaned up as part of closure. Tank systems closed to landfill standards must apply a final cover or cap and submit a Postclosure Plan. *Postclosure*, normally a 30-year period, applies only to land disposal facilities and facilities that cannot decontaminate all equipment, structures, and soils ("clean close"). Some proposed closure actions require postclosure. During postclosure, owners/operators conduct monitoring and maintenance activities to preserve the TFF disposal system integrity and continue to prevent or control contaminant releases from the TFF disposal units. Possible uses for the empty tank voids are:

1. Creating an LLW landfill for Class C radioactive grout as regulated by the NRC

2. Creating a respository for CERCLA waste.

This report documents:

Methods to safely close the 11 large underground storage tanks, tank vaults, interconnecting waste transfer lines and valving, tank cooling equipment, valve boxes, and instrumentation equipment entering the tanks and vaults

1. Possible methods for using empty tank voids as an NRC landfill for the disposal of Class C grout

2. Recommended path forward

3. Costs and schedules associated with the recommended Closure Plan(s)

4. Project Data Sheets (see Appendix A).

1.1 REFERENCES

1-1. Donald N. Rash, "Letter in Response to the DOE," October 24, 1994 letter, January 24, 1995.

2. SCOPE AND OBJECTIVES

This study identifies options to close the TFF at the ICPP in support of the INEEL HLW and Facilities Disposition EIS hereafter called the HLW EIS. The objectives and scope of this study are presented below.

2.1 Objectives

The primary objectives for this study are to:

1. Define and describe activities required for TFF Closure when the tanks are no longer used for normal operations (referred to as "cease use").

2. Provide the closure method recommendations. These recommendations will be based on the study findings and will identify issues that must be resolved before the closure method is considered viable.

3. Provide options for TFF Closure and subsequent use.

4. Provide subsequent use recommendations for the tank voids that will remain after closure.

5. Identify the major regulatory, compliance, and design requirements for each closure and subsequent use option.

6. Provide cost-bounding estimates for the TFF Closure and subsequent use options developed during the study.

7. Provide an estimated schedule outlining the major tasks with required start and completion times for the closure and subsequent use options developed.

2.2 Scope

To accomplish these objectives, the work scope includes:

1. Investigating and documenting regulatory requirements and compliance issues applicable to closing the TFF per RCRA closure standards.

2. Developing preliminary design information to support RCRA closure of eleven 300,000-gallon tanks and the respective tank vaults.

3. Developing preliminary design information to support RCRA closure of the TFF ancillary systems including waste transfer lines, valve boxes, instrumentation lines, air lines, tank cooling coils, vessel off-gas (VOG) piping, and electrical conduits.

4. Developing closure methods.

5. Developing preliminary design information to support subsequent use of the tank voids.

6. Developing subsequent uses for the tank voids.

7. Investigating and documenting regulatory requirements and compliance issues applicable to using emptied tanks as an LLW landfill meeting the criteria for NRC Class C waste.

8. Developing preliminary design information to support total TFF removal.

9. Providing cost and schedule information for the developed closure and subsequent use options.

2.2.1 RCRA Closure and Subsequent Tank Void Use

The study objectives to provide closure and subsequent use option recommendations were used to establish the two major areas of this study. This study investigates RCRA closure methods and then identifies subsequent uses for the tank voids that remain after closure is complete. Closure and subsequent use methods were developed using this methodology.

The closure methods are:

1. Total Removal Clean Closure (TRCC)

2. Risk-Based Clean Closure (RBCC)

3. Closure to RCRA Landfill Standards (CLFS).

The subsequent tank void uses are:

1. Create an LLW landfill that meets NRC requirements for placing NRC Class C waste in that landfill

2. Place waste generated from ICPP CERCLA remediation activities in the tank voids

3. Place clean grout in the tank voids.

The closure methods were mixed with the subsequent void uses to establish six closure and subsequent use options (see Section 2.2.2). The separate closure and subsequent use methods are discussed in the following subsections.

2.2.1.1 RCRA Closure

In support of the primary objectives listed above, TFF Closure methods were identified and developed to close the TFF in accordance with RCRA closure standards.

RCRA closure paths that have been identified for closing the TFF to RCRA rules and regulations are defined below. The first two RCRA closure methods are variations of clean closure in which the mixed (radioactive and hazardous) wastes are either partially or totally removed. The other closure method closes the TFF to RCRA landfill standards.

2.2.1.1.1 Clean Closure—Two types of RCRA clean closure were identified for further study and are listed below.

2.2.1.1.1.1 Total Removal—TRCC is defined for purposes of this study as:

1. Total removal of tanks, vaults, process piping, soils, and other contaminated components such that contaminants are no longer detectable above background level measurements within the TFF

2. Filling in the pit created during TRCC operations to grade level.

A detailed discussion on this form of RCRA closure and the various options that were evaluated can be found in Section 7.1 of this study.

2.2.1.1.1.2 Risk Based—RBCC is defined for purposes of this study as:

1. Leaving the tanks, vaults, and piping in place. This includes isolating each individual tank system from the rest of the TFF by cutting, grouting (as applicable), and capping the ancillary piping

2. Stabilizing the residual heel material in the tanks and vaults

NOTE: Heel stabilization, for this study, shall be defined as the process that includes washing, flushing, pumping, pH adjustment, heel displacement, and free liquid elimination.

3. Performing a material sampling and risk analysis of the remaining tank heel and vault contaminants

4. Verifying that the risk to public health from the remaining TFF residual heels meets the Closure Plan acceptance criteria and that the total TFF Closure risk, when combined with all other health risk sources at the ICPP, is consistent with the cumulative risk assessment limits for the ICPP

5. Filling the vault void to minimize the chance of subsidence within the TFF.

NOTE: Subsidence minimization for RBCC is not a regulatory requirement. Subsidence prevention for RBCC will be done as a best management practice.

This definition of RBCC leaves the tank voids open for subsequent use. The subsequent uses are identified in Section 2.2.1.2.

A detailed discussion on this RCRA closure method can be found in Section 7.2 of this study.

2.2.1.1.2 ***Closure to Landfill Standards.*** CLFS is defined for purposes of this study as:

1. Leaving the tanks, vaults, and piping in place. This includes isolating each individual tank system from the rest of the TFF by cutting, grouting (as applicable), and capping the ancillary piping

2. Stabilizing the residual heel material in the tank bottoms

3. Making provisions for a landfill monitoring system

4. Filling the vault void with grout to provide a cover over the tanks. This cover would minimize liquid migration through the landfill and minimize subsidence within the TFF.

NOTE: A CERCLA cap will cover the TFF once completely closed. This cap further limits liquid migration through the landfill and will be the primary liquid migration prevention system.

This definition of CLFS leaves the tank voids open for additional uses. These tank void uses are described in the next section.

A detailed discussion on this form of RCRA closure and the various scenarios that were evaluated can be found in Section 8.

2.2.1.2 Tank Void Subsequent Use

Filling the tank voids prevents tank subsidence. Methods to fill the tank voids were identified. Filling Methods 2 through 4 were developed and are discussed as part of the work scope (see Section 8.4). Filling Method 1 was not developed since this fill material would not provide the same level of subsidence prevention and, if used, would be bounded by the other methods.

Tank void filling methods identified include:

1. Filling the tank voids with sand, gravel, or other "clean" fill materials

2. Filling the tank voids with clean grout (i.e., grout that contains no radioactive or hazardous wastes)

3. Creating an "NRC Landfill" by filling the tank voids with LLW grout containing Class C radioactive waste

4. Filling the tank void with CERCLA waste.

2.2.2 TFF RCRA Closure and Subsequent Use Options

Six TFF Closure and subsequent use options were formulated by combining the three RCRA closure methods with the three subsequent tank void use methods. Option 1 has no subsequent use identified, as the TFF would be completely removed under this option.

Table ES-1, located in the executive summary, shows the closure and subsequent tank void use options identified by this study and the main actions conducted during closure and subsequent use operations. The closure and subsequent use option numbers were selected based on regulatory path criteria and does not indicate the recommended closure path order.

2.2.3 Regulatory Responsibility Transfer to CERCLA

RCRA CLFS requires cap installation over the entire facility and long-term monitoring. Cap installation and long-term monitoring are also required when using the tank void as an LLW landfill for near-surface disposal of Class C grout. The CERCLA program has also identified the need for capping and long-term monitoring at the ICPP due to the nature and extent of contaminants. To avoid duplication, the need to transfer regulatory responsibility for the TFF capping and long-term monitoring from RCRA or NRC to CERCLA has been identified. The actual CERCLA transfer timing and scope must be negotiated between the regulatory agencies involved in the TFF soil remediation and closure activities.

RCRA closure involves Options 1 through 6 as shown in Table ES-1. Only Options 2 through 6 require a regulatory authority transfer to CERCLA. The regulatory transfer timing of the various options, subject to negotiation, is discussed below.

2.2.3.1 Options 3 and 5 Transfer to CERCLA. Options 3 and 5 transfer the TFF from RCRA to CERCLA after:

1. Tank isolation (see Section 7.2.1 for Option 3 and Section 8.1 for Option 5)

2. Heel stabilization (see Section 7.2.2 for Option 3 and Section 8.2 for Option 5)

3. Placement of a cap inside the vault void (see Section 7.2.3 for Option 3 and Section 8.3 for Option 5).

For Options 3 and 5, the tank void is left empty for future use by CERCLA. CERCLA would assume the responsibility for managing the remaining tank voids, long-term monitoring, and installing a final cap or cover over the entire TFF. This study assumes that CERCLA waste will be placed into the tank void by CERCLA. The cost estimates for Options 3 and 5 include the cost of CERCLA waste installation. This allows a comparable cost analysis to be performed against all six options.

2.2.3.2 Option 6 Transfer to CERCLA. Option 6 transfers the TFF from RCRA to CERCLA after:

1. Tank isolation (see Section 8.1)

2. Heel stabilization (see Section 8.2)

3. Placement of a cap inside the vault void (see Section 8.3)

4. Placement of clean grout inside tank void (see Section 8.4).

For Option 6, the vault and tank voids would be filled with clean grout, then regulatory responsibility would be transferred to CERCLA for long-term monitoring and installing a final cap or cover over the entire TFF.

2.2.3.3 Options 2 and 4 Transfer to CERCLA. Options 2 and 4 Transfer to CERCLA. Options 2 and 4 require coordination between RCRA, NRC, and CERCLA programs to avoid duplication of effort associated with the responsibilities for installation of a final cap or cover, maintenance, and long-term monitoring. This would require negotiating the actual transfer points between RCRA, NRC, and CERCLA. These negotiated transfer points would define the regulatory responsibilities concerning the final cap or cover placement over the entire TFF, maintenance, and long-term monitoring. The expected transfer point where the TFF would be transferred from RCRA to NRC regulatory authority is after:

1. Tank isolation (see Section 7.2.1 for Option 2 and Section 8.1 for Option 4)

2. Heel stabilization (see Section 7.2.2 for Option 2 and Section 8.2 for Option 4)

3. Placement of a temporary cap inside the vault void has occurred (see Section 7.2.3 for Option 2 and Section 8.3 for Option 4).

The expected transfer point where the TFF would be transferred from NRC to CERCLA regulatory authority is after:

1. Placement of NRC Class C grout inside the tank void has occurred (see Section 7.2.4 for Option 2 and Section 8.4 for Option 4).

The responsibilities for final cap or cover installation over the entire TFF and long-term maintenance and monitoring would be transferred to CERCLA upon grout placement. The cost estimates for Options 2 and 4 include the cost of NRC Class C waste installation. This allows a comparable cost analysis to be performed against all six options.

NOTE: Negotiations with the various regulatory agencies (State of Idaho, EPA, NRC, and DOE) must take place at an early stage of the closure process. These negotiations would specify the responsibilities for each agency and identify the timing for regulatory transfer.

2.2.3.4 Option 1 with No Transfer to CERCLA. Option 1 does not transfer the TFF to CERCLA. This option removes all contaminants in the tanks, vaults, piping, and excavated soil. Therefore, no additional regulatory interaction is required at this point. Option 1 completes RCRA closure after:

1. The total removal of tanks, vaults, process piping, soils, and other contaminated components such that the risk associated with the contamination in the soil are below release criteria for the ICPP

2. Filling in the remaining pit created during TRCC operations to grade level.

3. TANK FARM DESCRIPTION

The TFF is used to temporarily store mixed waste until the waste is converted into a solid form at the NWCF. The TFF (see Figure 1-3) consists of mixed waste underground storage tanks, tank vaults, interconnecting waste transfer lines, valve boxes, valves, airlift pit, cooling equipment, and several small buildings containing instrumentation and valving for the waste tanks. This study focuses on closing the 11 large 300,000-gallon storage tanks and associated TFF items.

Presented below are descriptions of major components within the TFF. Major components include:

1. Tanks

2. Vaults

3. Process piping.

3.1 Tanks

The TFF contains stainless steel storage tanks with capacities ranging from 18,400 to 318,000 gallons[a]. The eleven 300,000 to 318,000-gallon tanks (see Figure 3-1) are contained in underground, unlined concrete vaults and will be referred to as "300,000-gallon" tanks in this report. The 300,000-gallon tanks store liquid wastes before calcination. These liquid wastes in the tanks are acidic, ranging in molarity from 0.43 to 2.65 moles H+/liter. The liquid wastes are regulated as a RCRA mixed waste (hazardous and radioactive) and are derived from a number of sources including: CPP-601 as extraction process raffinates; FAST; the PEW Evaporator System's bottoms; PEW/Cell floor drain tanks; the Headend Process and Process Cells; the Westside Hold-up tank; and the NWCF.

Waste inventory and characterization information are presented in Section 4.2 of the "Waste Inventories Characterization Study."[3-1] Characterization information includes chemical, radiological, and physical data for the high-level liquid wastes, sodium-bearing wastes (SBW), and the known solids and liquids that comprise the tank heels. The heels, for the purpose of this study, include the remnants of the stored waste and any precipitate remaining in the bottom of the tank after the tank is emptied as low as possible using existing liquid transfer equipment (steam jets or air lifts). Information concerning the EPA hazardous waste numbers and treatment standards for the TFF waste are identified in Tables 8-1 and 8-2 of the "Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-level Waste Program."[3-2] It should be noted that up to date heel characterization information does not exist and additional heel characteristic data are required before closure activities begin.

Eight of the eleven 300,000-gallon tanks contain stainless steel cooling coils to maintain the liquid waste temperature below 35°C for fluoride-containing waste and below 55°C for nonfluoride-containing waste. The liquid waste is maintained below these temperatures to minimize corrosion of the stainless steel tanks. The lower tank temperature also reduces the liquid surface evaporation rate. This lowered evaporation rate reduces condensation in the buried condenser offgas lines. Demineralized water in the cooling coils circulates through a closed system and is cooled in turn by secondary cooling water.

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[a] The 18,400-gallon and 30,000-gallon tanks are not covered within the scope of this study. The schedule for submittal of a Closure Plan to the State of Idaho for these tanks and their subsequent closure has not been identified. See Section 12.2.16 "Schedule for Closure of the 18,400 and 30,000 Gallon Tanks."

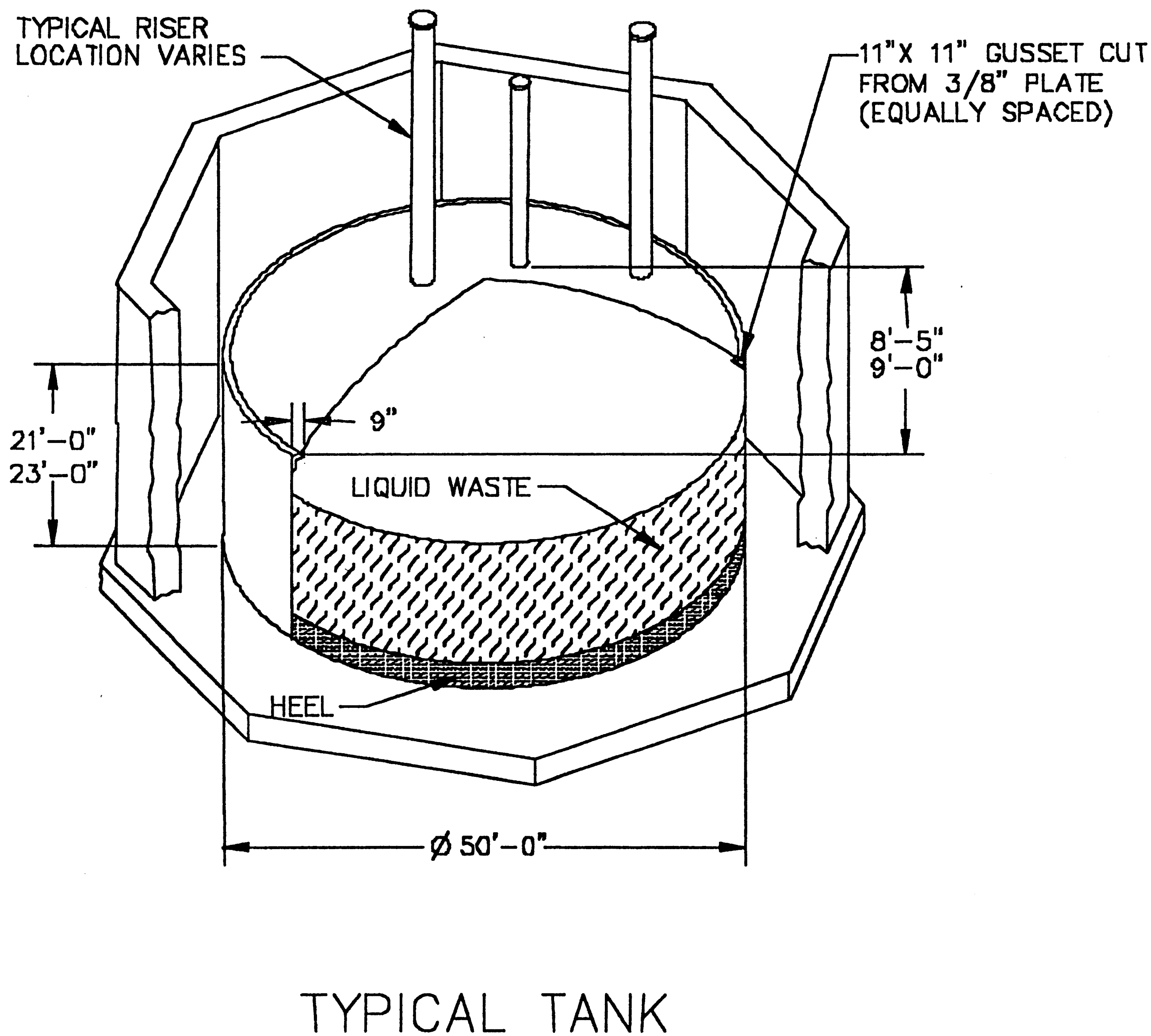


Figure 3-1. Typical Tank.

Access to the 300,000-tanks is provided through risers. Each tank has four to five 12-inch risers. Tanks WM-184 through WM-190 also have one to two 18-inch risers. Most risers have equipment installed in them such as radio frequency probes for level measurement, corrosion coupons, or waste transfer equipment (steam jets and air lifts). With the exception of Tanks WM-189 and WM-190, two steam jets are located inside each tank. WM-189 and WM-190 have one steam jet and one air lift per tank. A single steam jet can transfer waste out of a tank at approximately 50 gallons per minute (gpm) and an air lift can transfer waste out of a tank at approximately 35 gpm. Table 3-1 provides generalized information on the 300,000-gallon tanks.

As noted in Table 3-1, the dimensions and materials for Tanks WM-180 and WM-181 vary from the other tanks. WM-180 and WM-181 were constructed in 1951–52 and are slightly larger (318,000 gallons) than the other nine tanks (300,000 gallons). Tanks WM-182 through WM-184 were constructed in 1954–1955; WM-185 and WM-186 were constructed in 1955–1957; WM-187 and WM-188 were constructed in 1958–1959. Waste storage tank construction was completed when Tanks WM-189 and WM-190 were built in 1964.

3.2 Vaults

Each 300,000-gallon storage tank is totally enclosed in a concrete vault. The vaults vary in design (see Figure 3-2) but all are constructed of reinforced concrete. Tanks WM-180 and WM-181 are enclosed in cast-in-place octagonal vaults. Tanks WM-182 through WM-186 are enclosed in pillar-and-panel style octagonal vaults. Tanks WM-187 through WM-190 are enclosed in a cast-in-place square 4-pack. The 6-inches thick concrete roofs are covered with approximately 10 ft of soil for radiation protection of personnel. Tanks WM-180 and WM-181 are bolted to the floor of their respective vaults. Tanks WM-182 through WM-190 rest on a thin sand layer atop a concrete pad in the respective vault.

Table 3-2 provides generalized physical information about the tank vaults.

Vaults for WM-180 and WM-181 each contain one leak detection sump (120 gallons). Vaults for WM-182 through WM-188 each have two hot sumps (7.5 gallons/sump). WM-189 and WM-190 each have two hot sumps (22.5 gallons) and one larger cold sump (1,011 gallons). Cold sumps are used for rain water, snow melt, or any surface water infiltration. The sumps are equipped with liquid level sensors to detect tank contents or surface water leakage into a vault. Each vault sump has transfer jets (capacity of 20 gallons/minute) that empty sump contents to WL-102, WL-133, the PEW Evaporator feed collection tanks in CPP-604, or back into the tank enclosed by the vault. Vault sumps for WM-180 and WM-181 can be emptied to the alternate tank but not back to the tank enclosed by the vault.

The various tank and vault designs have different abilities to withstand a seismic event. Studies[3-3 through 3-8] were performed to determine if the vaults and tanks would meet seismic criteria set forth by DOE Standard 1020 and DOE-ID AE Standards. The cast-in-place octagonal vaults (WM-180 and 181) and the cast-in-place square 4-pack vaults (WM-187 through WM-190) have been qualified through studies to meet the seismic criteria. On the other hand, the pillar-and-panel octagonal vaults (WM-182 through WM-186) may not qualify[b]. Cease use of the pillar-and-panel vaults will occur before the other tanks because these vaults may not meet the seismic criteria.

[b] Initially none of the tank vaults passed a seismic analysis. Later, a more refined analysis was performed to show that six of the 11 vaults met the current requirements. Such a refined analysis was planned for the remaining five vaults, but was cancelled due to a lack of funding. It was thought, however, that they could also pass but it was never proven because the analysis was not performed. Also, today's seismic requirements would be less stringent then those against which the original analysis was performed. The original analysis was performed to an equivalent safety hazards analysis Performance Category (PC) of PC-4; today an analysis would use PC-3.

Table 3-1. Design information summary for Tanks WM-180 through WM-190.[a]

	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Design Organization	Foster-Wheeler	Foster-Wheeler	Blaw-Knox	Blaw-Knox	Blaw-Knox	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.
Tank Subcontractor	Chicago Bridge & Iron (CBI)	CBI	CBI	CBI	CBI	CBI	CBI	Hammond Iron	Hammond Iron	Industrial Contractors	Industrial Contractors
Years Constructed	1951-1952	1951-1952	1954-1955	1954-1955	1954-1955	1957	1955-1957	1958-1959	1958-1959	1964	1964
Initial Service Date	1954	1953	1955	1958	1958	1959	1962	1959	1963	1966	Spare
Design Codes	Unknown	Unknown	API-12C	API-12C	API-12C	API-12C	API-12C	API-12C	API-12C	API-650	API-650
Cooling Coils	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Tank Diameter (feet)	50	50	50	50	50	50	50	50	50	50	50
Tank Height to Springline (feet)	23	23	21	21	21	21	21	21	21	21	21
Tank Capacity (gal)	318,000	318,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Lower Tank Thickness (inches)	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125
Upper Tank thickness (inches)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Corrosion Allowance (mils)	Unknown	Unknown	125	125	125	125	125	125	125	125	125
Type of Stainless Steel	347	347	304L	304L	304L	304L	304L	304L	304L	304L	304L
Design Specific Gravity	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

Physical Characteristic	**Dimensions**	
Dome Height	8 ft-6 in. – 9 ft[a]	
Approximate Total Tank Volume	2,000 yd^3 [a,b,c]	1,825 yd^3 [a,b,d]
Approximate Dome Volume	330 yd^3 [a,e,c]	300 yd^3 [a,e,d]

a. Values shown in table are approximations to aid in cost estimation and provide a general tank description.

b. Estimated volume is based on the physical tank volume not the tank capacity.

c. Calculated volume for Tanks WM-180 and WM-181.

d. Calculated volume for Tanks WM-182 through WM-190.

e. Volume calculated using standard spherical cap equation, a diameter of 50 ft., and appropriate dome height.

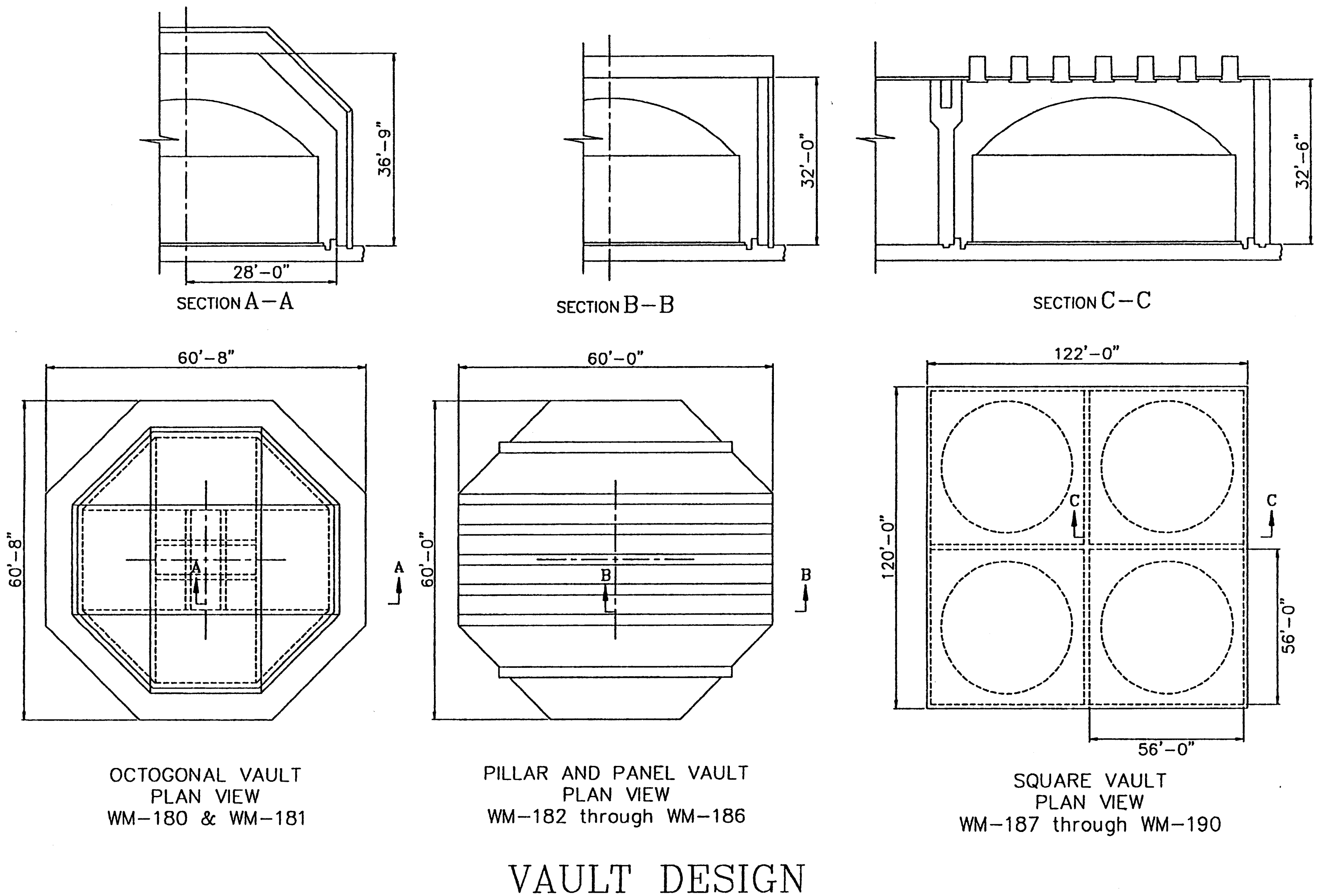


Figure 3-2. Vault Design.

Table 3-2. Vault description.[a]

Vault Type	Dimension
Type: Octagonal Cast-in-Place Used on: WM-180 and WM-181	
Inside octagonal width	56 ft – 0 in.
Height	36 ft – 9 in.
Approximate vault volume	3,550 yd^3
Approximate vault volume minus tank volume	1,500 yd^3
Type: Octagonal Pillar & Panel Used on: WM-182 through WM-186	
Inside Octagonal Width	58 ft – 10 in.
Height	32 ft – 0 in
Approximate vault volume	3,100 yd^3
Approximate vault volume minus tank volume	1,100 yd^3
Type: Square Cast-in-Place Four Pack Used on: WM-187 through WM-190	
Overall outside four pack dimensions	120 ft - 0 in. x 122 ft - 0 in.
Single vault dimensions (inside)	56 ft - 0 in. x 56 ft - 0 in.
Height	32 ft – 0 in.
Approximate vault volume	3,750 yd^3
Approximate vault volume minus tank volume	1,750 yd^3

a. Values shown in table are approximations to aid in cost estimation and provide a general tank description.

An engineering study[3-9] was performed to evaluate the effects of various vehicle loads on the TFF vaults. The study was initiated because of a specific concern that large cranes, multiple trucks, or other equipment placed within the TFF could damage or collapse the TFF vaults. Vault damage would most likely cause damage to the tank contained inside. Based on this study, load limits were established for vehicular loads within the TFF to ensure the TFF vaults were not overstressed. Before entry into the TFF, load configurations that might exceed limits specified by established load studies must be evaluated to ensure damage to the vaults does not occur. See Section 6.2 for a detailed discussion of this subject.

3.3 Waste Transfer Systems

Liquid wastes from the various plant areas at ICPP are transferred to the TFF through underground, stainless steel lines. High-level liquid waste was either transferred directly to one of the 300,000-gallon storage tanks, or was directed to Tanks WM-100 through WM-102 for temporary storage. These HLW generating processes have ceased and the lines from these processes to the tanks have been capped. Concentrated PEW Evaporator bottoms are directed to Tank WL-101 for temporary storage, then transferred to one of the 300,000-gallon storage tanks. Steam jets or airlifts with nonmoving parts are used to transfer wastes throughout the TFF.

All buried lines that transport waste are enclosed in pipe encasements. Originally, there were three main types of pipe encasements in the TFF: split tile, stainless steel-lined concrete troughs, and double-walled stainless steel pipe. However, during recent TFF upgrades (1993–1995), pipe sections encased with the split tile have either been replaced or abandoned in place. Waste transfers currently take place through pipes housed in stainless steel-lined concrete troughs or double-walled stainless steel pipe. Mixed waste lines are generally covered with 10 to 15 feet of soil.

Waste leaking from a line into an encasement drains into a valve box sump where it is detected by radiation instruments and/or sampling. A leaking line is immediately taken out of service and is not reused until it has been repaired. Wastes collected in the valve box sumps are jetted to tank WL-133 or drained to valve box C-12. Wastes collected in valve box C-12 are jetted to WL-133.

Waste transfer valves are located in stainless steel-lined, reinforced concrete boxes and manually operated using reach rods. The valve boxes are designed to provide access to the valves for inspection and maintenance. Manually operated valves control liquid waste routing within the TFF and also between the process areas and the TFF. During the recent upgrades, some original bellow seal globe valves were replaced with remotely repairable ball valves. New valve boxes were built as necessary.

Buried concrete junction boxes are located at points of direction change in pipe runs. These junction boxes serve as protection for pipe joints and were installed to permit access to underground piping for future line modifications and valve installation.

3.4 References

3-1. R. S. Garcia, *Waste Inventories Characterization Study,* INEL/EXT-97-00600, September 1997.

3-2. DOE, *Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-Level Waste Program*, DOE/ID-10544, October 1996.

3-3. Advanced Engineering Consultants, Inc., *Seismic Analysis and Evaluation of Octagonal Waste Tank Vaults WM-180 & WM-181 at the Idaho Chemical Processing Plant*, February 1991.

3-4. EQE International, *Seismic Evaluation of Waste Tank Vaults at the Idaho Chemical Processing Plant*, November 1988.

3-5. Advanced Engineering Consultants, Inc, *Preliminary Seismic Evaluation of Post and Panel Waste Tank Vaults WM-182 to WM-186*, April 1991.

3-6. Advanced Engineering Consultants, Inc., *Addendum to Chapter 4 of 'Seismic Analysis and Evaluation of Waste Tank Vaults WM-180 & WM-181 and WM-187 through WM-190 at the Idaho Chemical Processing Plant, Idaho National Engineering Laboratory,' August 1990*, March 1993.

3-7. EQE International, Job Number 52123.06, *Independent Review of Additional Seismic Analysis and Evaluation of Tanks WM-180 & WM-181 and WM-187 through WM-190*, March 1994.

3-8. John A. Blume & Associates, Engineers, *Seismic Analysis and Evaluation of Waste Tank Vaults WM-180 & WM-181 and WM-187 through WM-190 at the Idaho Chemical Processing Plant Idaho National Engineering Laboratory*, October 1990.

3-9. Lincoln Malik and Said Bolourchi, *Evaluation of Existing Vaults for Vehicle loads, HLWTFR Project,* Advanced Engineering Consultants, Inc., San Francisco, CA, August 1993.

4. REGULATORY AND ENVIRONMENTAL ANALYSIS

This section identifies the primary federal and state permits, licenses, and other entitlements associated with protection of the environment and public that are anticipated to be required for the IHWMA, RCRA Closure of the TFF, and NRC licensing as a near surface LLW disposal site. Because the action and associated impacts are undergoing refinement as additional information becomes available, this section will be revised as necessary to reflect the project and regulatory status.

Appendix B provides a summary of laws, regulations, executive orders, and DOE orders that are applicable, in general, to an INEEL project. Specific laws or activities anticipated to require permits, approvals, or revision due to the proposed actions are identified in Table 4-1. Additional information on issues such as the IHWMA, RCRA TFF Closure, and NRC permitting has been provided in the sections following the table. A list of requirements and assumptions are provided in Section 5.

4.1 Tank Radioactive Waste Classification

Radioactive waste disposal or storage is regulated by DOE and the NRC pursuant to the Atomic Energy Act and the Energy Reorganization Act. DOE's guidance for classifying waste is contained in DOE Order 5820.2A, "Radioactive Waste Management." The order classifies waste into HLW, LLW, and transuranic, hazardous, and mixed waste. NRC guidance on waste classification is contained in 10 CFR 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories," and in 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." HLW is defined in 10 CFR 60 as:

1. Irradiated reactor fuel.

2. Liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel.

3. Solids into which such liquid wastes have been converted. LLW is classified as A, B, C, and greater-than-Class C in 10 CFR 61.55.

Radioactive waste classification determinations involve two primary considerations:

1. Consideration must be given to long-lived radionuclide concentrations whose potential hazard will persist long after such precautions such as institutional controls, waste form, and deep disposal have ceased to be effective

2. Consideration must be given to shorter-lived radionuclide concentrations for which requirements on institutional controls, waste form, and disposal methods are effective. Presently, DOE LLW disposal is not regulated by the NRC; however, NRC rulings regarding waste treatment and waste feed limitations will affect classifying waste subject to HLW disposal requirements.

A waste radioactive classification analysis has been conducted on the TFF waste based on existing rules, laws, regulations, and implementing DOE orders associated with radioactive waste disposal.[4-1] This analysis identified a path forward for sodium-bearing and calcined waste management in the tanks. The analysis identified that "the sodium-bearing waste should not be classified as HLW since it originated from sources that are predominantly incidental to spent nuclear fuel reprocessing." The report noted that

Table 4.1. Potential permits and approvals for tank closure and use as radioactive waste disposal site for NRC Class C grout.

Law, Order, Consent Order Impacted	Discussion
Atomic Energy Act (AEA) and Energy Reorganization Act	During closure, tank heel will be sampled and characterized to verify that it meets incidental LLW standards. Heel characterization will determine NRC and DOE regulations applicability and compliance with the Batt Agreement. Information will also be used to support risk assessment calculations.
Clean Air Act (CAA) and National Emission Standards for Hazardous Air Pollutants (NESHAPs)	RCRA Closure and Class C grout emplacement: CAA – Permit to construct (PTC); NESHAPs – Application to construct (ATC) is required if radionuclide emissions exceed .1 mrem/yr using 40 CFR 61 App. D criteria. Continuous monitoring is required for each source with the unmitigated potential emissions > .1 mrem/yr. NESHAPs analysis will include potential emissions from radiolysis of Class C grout and heel.
HWMA (RCRA) Closure	HWMA closure of the TFF requires Closure Plan submittal to and approval from the State of Idaho. All activities would be conducted in accordance with the approved plan.
National Historic Preservation Act	Requires consultation with Idaho State Historic Preservation Officer and compliance with substantive requirements identified.
NRC Licensing as Near-Surface Disposal Area (AEA) (NRC Class C Grout Option only)	Legislation pending. Currently, DOE LLW disposal facilities are not regulated by NRC, but future NRC oversight is being evaluated.
RCRA Subtitle D Landfill Requirements applicable to NRC Class C Disposal Site (40 CFR 257)	Disposal of NRC Class C waste would be required to meet equivalency of RCRA Subtitle D landfill standards. Compliance to Subtitle D standards are required for disposal of treated mixed waste (i.e., waste that no longer exhibits any hazardous characteristics and has been delisted).
Executive Order 11988 (Floodplain Management).	Evaluate site w/ final floodplain maps (to be developed by others and approved by DOE). Prepare NRC analyses to determine impacts if manmade flood barriers are not in place; identify ability of design to mitigate impact.
INEEL Site Treatment Plan (STP)	Estimate waste volume generated from activities. If the volume of waste generated exceeds the STP volumes, update plan. Plan is updated annually.
Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)]	CERCLA coordination required. CERCLA sites in WAG 3 would be impacted due to ground-disturbing activities at the TFF. Wastes and residue left in place (or emplaced) would require evaluation to determine the impact to the CERCLA Record of Decision (ROD).
3/3/92 Consent Order (w/ 3/17/94 Mod)	3/31/09 cease use of Tanks WM-182, 183, 184, 185, 186, and vaults. Also identifies lines. 6/30/15 cease use of Tanks WM-180, 181, 187, 188, 189, 190 and vaults. Also identifies lines, valves, and junction boxes.
Settlement (Batt) Agreement	Identifies that all sodium-bearing waste treatment is to be completed by December 31, 2012.
Stormwater Pollution Prevention Plan (SWPPP)	Modify ICPP SWPPP to address impacts from activity.

the sodium-bearing waste exceeds NRC Class C waste limits because of transuranics only. The removal of approximately 99% of the transuranics would reduce the waste to below the Class C limit and the feasibility of technology to remove the transuranics has been demonstrated. The nonsodium-bearing waste is considered HLW when gauged against 10 CFR, Part 60. Part 60 defines HLW as irradiated reactor fuel, liquid wastes resulting from operation of first-cycle solvent extraction system, or equivalent, and the concentrated waste from subsequent extraction cycles or equivalent, in a facility for reprocessing irradiated reactor fuel and solids into which such liquid wastes have been converted. The report identified that sodium-bearing waste and newly generated waste from decontamination activities are not a result of first cycle raffinate or subsequent extraction cycles (Reference 4-1).

In response to a petition from the State of Washington and others, the NRC determined that only the most radioactive raffinate solutions, such as first-cycle raffinate, might be HLW, while the other waste streams of lower activity are incidental wastes and fall into another category. These incidental wastes include such wastes as ion exchange resins, some sludges, and waste generated from further treatment of HLW. This treatment of any wastes to meet Class C limits would occur before emplacement of the grouted waste in a near-surface waste radioactive disposal landfill.

The heel remaining in the tank system will be characterized as part of the tank decontamination and preclosure activities. This information will be used to verify that the heel is not HLW as defined by applicable regulations, DOE orders, and NRC requirements.

4.1.1 Incidental Waste Determination

TFF Closure is dependent upon meeting the Incidental Waste Criteria for the HLW residue (nonsodium-bearing waste residue) remaining in the tanks. Meeting these criteria would require a demonstration that this residue is an incidental waste and not HLW. This demonstration would be based on guidance provided by NRC's Incidental Waste Criteria (FR Vol. 58, No. 41, p. 12342). A point by point analysis of how the TFF Closure would achieve the Incidental Waste Criteria is discussed in the following sections.

4.1.1.1 Processed to the Maximum Extent Practical. The HLW must be or has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical.

Analysis: This criterion has not been established for in situ wastes. Because of a lack of guidance, it is the intent of this discussion to develop a rationale for why the tank residue would meet the incidental waste criteria based on the proposed clean closure activities.

> **Discussion of NRC's Intent**: The NRC identified the standard employed in distinguishing HLW from incidental waste and the policies that underlie the adoption as follows: (FR Vol. 58, No. 41, p. 12342)
>
> The clearest expression of the overall regulatory objectives is the Atomic Energy Commission's (AEC's) explanatory statement when it promulgated appendix F-namely, "that the public interest requires that a high degree of decontamination capability be included in such facilities and that any residual radioactive contamination after decommissioning be sufficiently low as not to represent a hazard to the public health and safety." 35 FR 17530, November 14, 1970. As we read the AEC's intent, the reference to "a high degree of decontamination capability" leaves a substantial degree of discretion. It certainly does not rule out consideration of economic factors as well as technical ones. It was the AEC's contemporaneous practice to consider financial impacts as, for example, in controlling releases of radioactive materials from licensed facilities to the lowest levels "technically

and economically practical." AEC Manual Chapter 0511. When the AEC spoke of a "high degree" of decontamination capability, we believe that it was guided by similar considerations. Moreover, from a policy standpoint, this makes good sense, for so long as there is adequate protection of public health and safety, it would not be prudent to expend potentially vast sums without a commensurate expectation of benefit to health and the environment.

Achieving a "high degree of decontamination capability" implies, then, that the facility should separate for disposal as much of the radioactivity as possible, using processes that are technically and economically practical. In addition, however, as the AEC's statement indicates, the residual radioactive contamination should be sufficiently low as not to endanger public health and safety.

These principles-high decontamination capability and protection of health and safety-are the essential benchmarks that have influenced the development of NRC's position vis-a-vis DOE on the question of the proper classification of the tank wastes and grout at Hanford.

Application of Closure of the TFF to AEC Intent: In review of the AEC's intent, the TFF Closure fully meets the original intent. The TFF Closure provides a high degree of decontamination capability and establishes that residual radioactive contamination after decommissioning is sufficiently low as not to represent a hazard to the public health and safety. This is documented by the performance of a risk assessment. The actual level to which the tanks will be decontaminated depends on the economic and technical feasibility of the selected closure method. The following is a discussion of compliance with the Incidental Waste Criteria.

4.1.1.2 Technically and Economically Practical. The criteria for technically and economically practical are determined by the total life-cycle cost per curie removed and the point where additional removal costs increase significantly. As only technically practical TFF decontamination methods are considered, this meets the technically and economically practical criteria.

4.1.1.3 Solid Physical Form. The incidental wastes will be incorporated in a solid physical form at a concentration that does not exceed that applicable concentration limits for Class C low-level waste as set out in 10 CFR part 61.

Analysis: As part of the closure process, heel removal will be conducted. This heel removal process, consisting of heel flushing, agitation, and removal is expected to reduce the concentration of any remnants of the radioactive heel remaining in the tanks to the required levels. Upon completion of the heel removal process, grout would be placed in the tank system using a grout placement system. It is projected that the solidified heel remnants would not exceed the applicable concentration limits for Class C LLW as set out in 10 CFR part 61.

4.1.1.4 Managed Pursuant to the Atomic Energy Act. The incidental wastes are to be managed pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR part 61 are satisfied.

Analysis: Class C limits are linked to:

1. A 500 year, 500 mrem/year dose standard to a hypothetical member of the public

2. Providing a 10,000 year protection standard for groundwater resources.[c]

Additional requirements include protection of individuals from inadvertent intrusion (10 CFR 61.42), protection of individuals during operations (10 CFR 61.43), and disposal site stability after closure (10 CFR 61.44). The closure methods being proposed are expected to meet this standard based on engineering judgement.

4.1.1.5 Incidental Determination for Risk-Based Closure Tank Residue. Based on the previous analysis, closure decontamination effluent and the nonsodium-bearing residual wastes remaining in the tank after closure should be classified as incidental waste. These wastes are remnants from the tank emptying and decontamination process and would be wastes incidental to the process of recovering HLW.

4.2 Air Permitting Applicability

An air permit applicability determination (APAD) will be prepared to assess the potential air and radionuclide emissions from the proposed activity. Idaho regulates emissions associated with the Clean Air Act (CAA) pollutants. These regulations for the control of air pollution that are found in IDAPA 16.01.01, Rules of the Department of Health and Welfare, Title 01, Chapter 01, "Rules for the Control of Air Pollution in Idaho." It is anticipated that the RCRA Closure and filling with NRC grout will require a permit to construct (PTC) from the State of Idaho as identified in IDAPA 16.01.01.201.

Potential radionuclide emissions are also regulated by EPA through the National Emission Standards for Hazardous Air Pollutants (NESHAPs) regulations. To determine NESHAPs compliance, modeling is conducted to establish the dose to the maximally exposed individual (MEI) at that site boundary. If the modeled unmitigated potential emissions exceed 0.1 mrem/yr, then a continuous emissions monitor would be required on new or modified emission source. If the radionuclide emissions exceed .1 mrem/yr using 40 CFR 61 Appendix D criteria, an application to construct (ATC) would be required. This monitoring would be required of all emission points for activities associated with the RCRA Closure and NRC Class C grouting.

4.3 IHWMA (RCRA) Closure

The State of Idaho regulates the hazardous components stored in tanks such as those at the TFF through the Idaho Department of Health and Welfare (IDHW) Rules, Regulations, and Standards for Hazardous Waste, adopted pursuant to the IHWMA. The IDHW Division of Environmental Quality's (DEQ's) Hazardous Waste Permitting Bureau (HWPB) is the state organization with closure oversight of IHWMA regulated facilities. The IHWMA incorporates the federal regulations of RCRA. For purposes of this analysis, the RCRA citations adopted by the State of Idaho are provided in lieu of the Idaho Administrative Procedure Act (IDAPA) citation in order to avoid confusion. This analysis also uses the term "clean closure" to identify an IHWMA-regulated unit where the waste was removed (complete or total removal) or rendered nonhazardous or of minimal risk to public health and the environment. This determination maybe supported by a risk assessment.

[c] Cochran, J. R. and Shyr, L. J., "Regulatory Closure Options for the Residue in the Hanford Site Single-Shell Tanks," Sept. 30

4.3.1 Regulatory Overview

The closure and postclosure regulations can be divided into two parts:

1. General standards in 40 CFR Parts 264/265, Subpart G

2. Technical standards for specific types of hazardous waste management units found in Parts 264/265, Subparts I through X. Part 264 regulates TSDFs that have received a Part B permit, while Part 265 regulates those facilities that are "interim status" facilities that have not yet received a Part B permit.

The TFF is currently composed of interim status units and would be closed under Part 265. The TFF is also impacted by a Notice of Noncompliance (NON) issued by the State of Idaho on January 29, 1990. The resulting Consent Order was signed on April 3, 1992. The NON was based primarily on secondary containment issues for the TFF and hazardous waste storage. Section 6.10 of the Consent Order provides schedules for either bringing the TFF into compliance with secondary containment requirements or closing the tanks. On March 17, 1994, the NON Consent Order was modified to incorporate terms of the "Settlement Agreement" (a.k.a., the Batt Agreement) among DOE, the State of Idaho, and the Navy.

The closure requirements ensure that a specific unit or facility will not pose a future threat to human health or the environment after a TSDF closes. Each facility must be closed in a manner that minimizes the need for care after closure; controls, minimizes, or eliminates the escape of hazardous waste, hazardous leachate, or hazardous waste decomposition by-products; and meets the closure requirements for each type of unit (40 CFR 265.111).

Facilities such as those found at the INEEL often have several different hazardous waste management units that close at different times. The regulations account for this possibility by differentiating between partial closure and final closure. Partial closure means closure of one or more hazardous waste management units at a facility where other hazardous waste management units remain active. The closed portion (also "inactive portion") of a facility is defined as that portion of a facility that has been closed in accordance with an approved Closure Plan and applicable regulatory requirements, while the active portion of the facility is that portion where treatment, storage, or disposal operations are being conducted and which is not closed. Final closure of a facility occurs when all hazardous waste management units at a facility are closed according to closure regulations so that waste management activities under Parts 264/265 are no longer conducted at the facility (40 CFR 260.10).

All TSDFs must submit Closure Plans for both partial and final closure in accordance with 40 CFR 265.112. These plans explain in detail how the owner or operator will achieve the closure performance standard under 40 CFR 265.111. Closure plans are subject to approval by the State of Idaho and, following approval, all closure activities are conducted in accordance with the plan.

4.3.2 IHWMA (RCRA) Closure Standards for the Tank Farm Facility

The TFF consists of 11 interim status units regulated as tank systems (40 CFR Subpart J). The TFF does not currently have State of Idaho approved Closure Plans meeting the standards found in 40 CFR 265.197. This analysis provides information associated with alternative methods of closure and void filling for evaluation in the INEEL HLW EIS. It is anticipated that this EIS will evaluate these alternatives and identify a preferred closure method for the TFF. This information would then be used to develop a Closure Plan for the State of Idaho's review and approval. The following section provides information on the closure schedule and requirements associated with tank systems regulated under the IHWMA (RCRA).

4.3.3 Mechanisms for Closure Plan Submittal

Closure Plan submittal to the State of Idaho for INEEL interim status units may be accomplished by two mechanisms. The first, and most common method, is the identification of the Closure Plan's submittal date in the *"RCRA Part B Permit Application Workplan for the Idaho National Engineering Laboratory."* Closure schedules identified in the work plan are prioritized based on factors such as :

1. Pending discontinuation of a TSDF's operations

2. Waste volume to be removed

3. Condition of the unit

4. Any potential threats to human health and the environment that may exist.

The second method of submittal is the identification of a unit's closure schedule through the judicial system - normally a Consent Order that is in response to an NON. The schedule for submittal of the TFF Closure Plan to the State of Idaho has not been identified in the workplan or in a Consent Order.

4.3.4 Closure Schedule

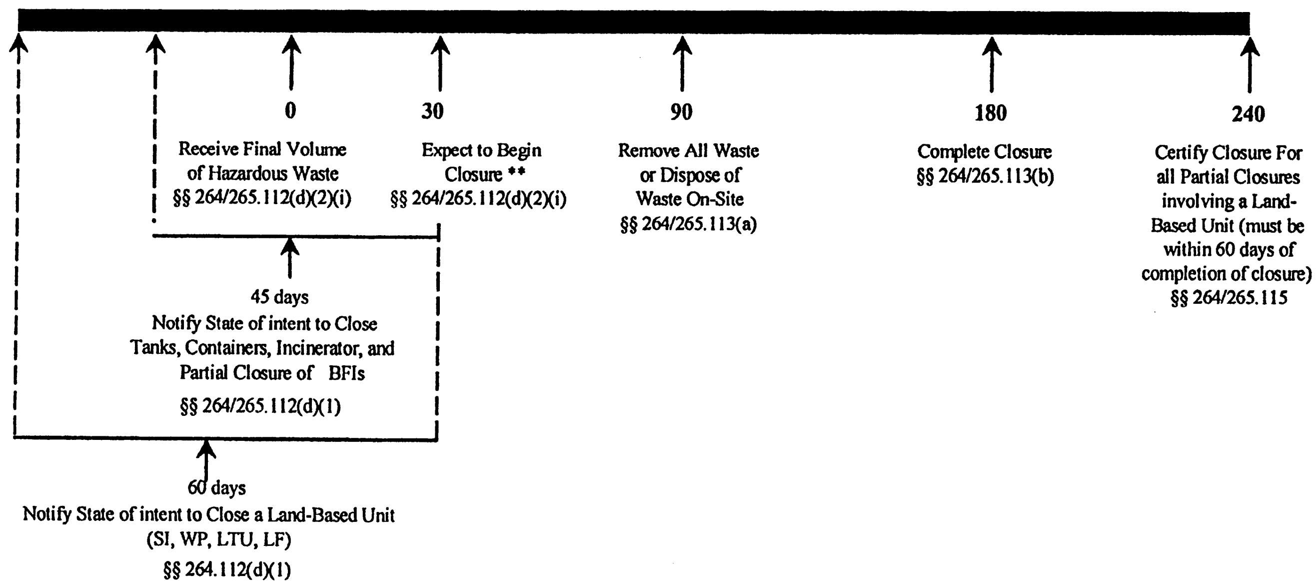
Closure regulations establish specific timetables for closure activity initiation and completion. Figures 4-1 and 4-2 depict the typical closure timetables for systems with and without approved Closure Plans. One element of this timetable is prior notification to the IDHW of closure commencement. The Closure Plan for a tank system (and notice of pending closure) must be submitted to the IDHW at least 45 days before the date that final closure is expected. Then, the owner or operator must treat, remove from the site, or dispose of all hazardous waste onsite within 90 days of receipt of the final hazardous waste volume, or within 90 days of the Closure Plan approval, whichever is later [40 CFR 265.113(a) and (b)].

The regulations identify that closure activities must be completed within 180 days of Closure Plan approval, or within 180 days of receiving the final volume of hazardous waste, whichever is later. Closure plans may provide for a schedule extension and decontamination sequence to handle complex systems such as a multiple tank system like the TFF.

4.3.5 Overview of RCRA Closure Alternatives and Requirements

Closure provides for the removal or decontamination of all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and appropriate management. If the owner or operator demonstrates that not all contaminants can be practicably removed or decontaminated as required, then the owner or operator must close the tank system and perform postclosure care of the system in accordance with the closure and postclosure care requirements that apply to landfills (40 CFR 265.310). In addition, for the purposes of closure and postclosure, such a tank system is then considered to be a landfill, and the owner or operator must meet the requirements for landfills specified in 40 CFR, Subparts G and H.

(40 CFR 264/265)



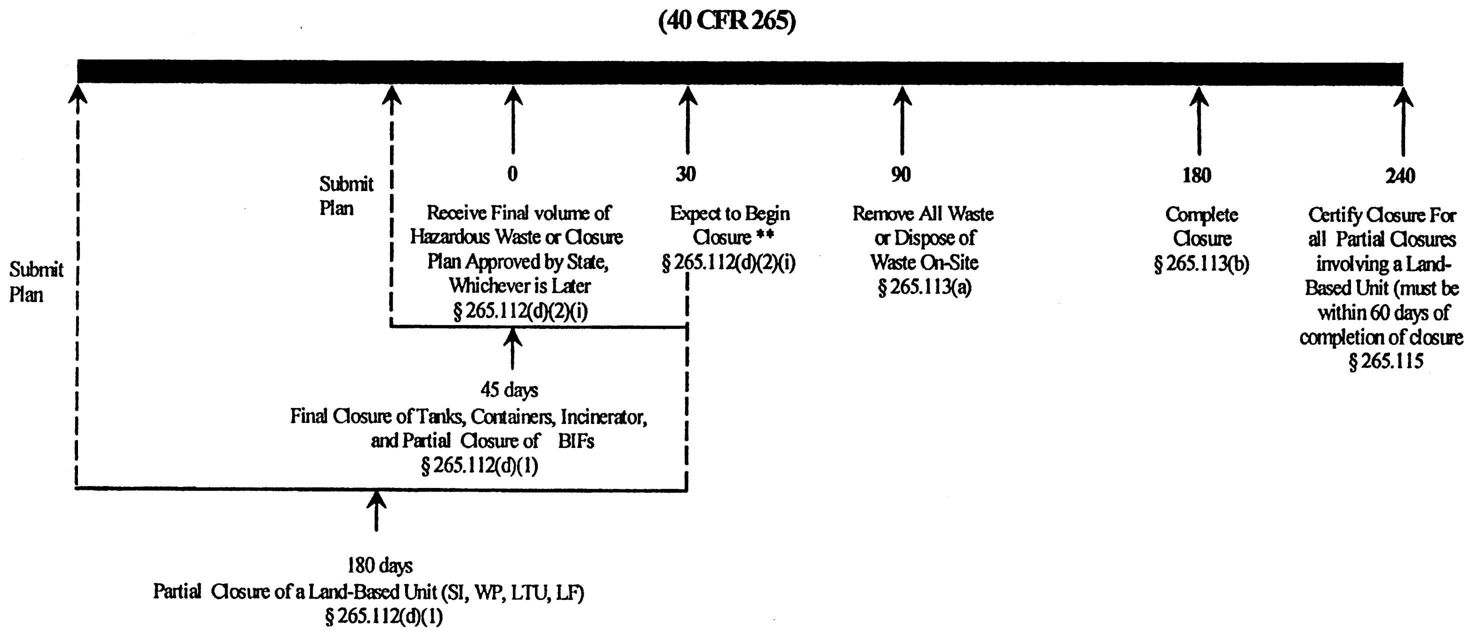
* This figure does not take into account Delay of Closure Rules

** If the unit has the capacity to receive additional wastes, begin closure no later than 1 year after receiving final volume of waste

ACRONYMS:

SI	surface impoundment	LF	landfill unit
WP	waste pile	BFI	boiler or industrial furnace
LTU	land treatment unit		

Figure 4-1. Closure timetable for facilities and interim status facilities with approved Closure Plans.



If the unit has the capacity to receive additional wastes, begin closure no later than 1 year after receiving final volume of waste.

* This figure does not take into account Delay of Closure Rules

**

ACRONYMS:

SI	surface impoundment	LF	landfill unit
WP	waste pile	BIF	boiler or industrial furnace
LTU	land treatment unit		

Figure 4-2. Closure timetable for interim status facilities without approved Closure Plans.

Wastes (e.g., equipment and materials to be disposed, equipment decontamination residuals and rinsates, and personal protective equipment) would be generated by the closure activities. These wastes, called "newly generated wastes" would require a hazardous waste determination. Newly generated hazardous waste would have special requirements for its management imposed due to the waste codes. Environmental Protection Agency (EPA) has restricted the land disposal of untreated hazardous waste under 40 CFR 268 (known as land disposal restrictions or LDRs). The regulations require that waste be treated to a treatment standard based on the performance of the best demonstrated available technology (BDAT) for that waste. These treatment standards can either be numerical (expressed as a concentration of the hazardous constituent), or technology-specific (requiring the use of a specific technology). Waste codes may be removed by demonstrating to EPA that the waste is no longer hazardous through a formal delisting process (40 CFR 260.22) or by a determination of equivalent treatment (DET) [40 CFR 268.42(b)].

The following provides a discussion of potential TFF Closure methods.

4.3.5.1 Risk Assessment Supported Closure. The State of Idaho HWPB has identified the need to support "clean closure" of regulated systems by using risk assessments if contamination from waste remains in place. The purpose of a risk assessment is to evaluate the impacts to human health and ecological health that could result from exposure to site contaminants. For consistency with the FFA/CO, CERCLA risk assessment methodologies are used. The risk assessment provides an analysis of baseline risks and identifies the degree of hazard or threat that exists. Based on the risk assessment, the need for action is identified and the degree of short- and long- term effectiveness of various closure methods is established. For example, the risk assessment may identify that decontamination is successful and risks to human health and the environment are "acceptable."[d] In this scenario, the unit would be "clean closed" as identified below. If the risk assessment identifies potential "unacceptable" risks, the unit would receive additional decontamination or be closed as a landfill so as to protect human health and the environment over the long term.

4.3.5.2 Closure with Contaminant Removal (Clean Closure). If all hazardous waste, contaminants, and waste residue including contaminated soils and equipment, can be removed from the site or unit at closure, the site or unit can be "clean closed" and postclosure care is not required. "Clean Closure" requires the removal of all waste residue; the decontamination of equipment and structures to be left in place; and the proper management of equipment and wastes that are removed. This may be demonstrated by two methods. The first method is achieved by the complete tank system and contaminants removal. The second method is a risk-based method. This method requires that an owner or operator demonstrate that hazardous contaminants levels remaining after decontamination do not exceed the risk-based performance standard.

For both methods, a site-specific decontamination plan is developed to establish the most appropriate cleanup method or combination and/or sequence of methods that would achieve the closure performance standard. Factors considered in the decontamination plan include:

1. Worker and environmental health and safety requirements

2. Volume and type of wastes generated (waste minimization)

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[d] Acceptable as defined by the Closure Plan's predetermined standard. This standard is anticipated to be between 10^{-4} to 10^{-6} for carcinogens. This would correspond to a cancer incidence of 1 in 10,000 (10^{-4}) to 1,000,000 (10^{-6}). This says that for a person exposed to a reasonable maximum amount of contaminant, his order increase in cancer risk would be 1 in 10,000 to 1 in 1,000,000.

3. Cost and schedule

4. Future use of equipment and facilities.

Following waste removal and achievement of the closure performance standard, postclosure care or filing of a plat would not be required as the system is no longer regulated under RCRA.

4.3.5.2.1 Clean Closure With Total Removal—This clean closure method provides for the complete removal of contaminated TFF components including tanks, vaults, piping, and valve boxes. Following removal, these contaminated components would require treatment and disposal in accordance with LDRs at an onsite or offsite facility. If spills or releases to the soil occurred as part of the removal (post-CERCLA), these contaminated soils would also require removal and treatment as part of the closure activity.

4.3.5.2.2 Risk-Based Clean Closure—The State of Idaho HWPB has provided guidance that identifies the performance standard associated with known or suspected carcinogens as below detectable levels (<detect) or having a risk of less than 10^{-4} (one excess or additional cancer occurrence in 10,000 population). However, the acceptable level for risk may change from site to site based on future land use, adjacent uses, etc. Performance standards associated with noncarcinogenic effects are identified through the calculation of the hazard quotient. A hazard quotient of less than one indicates that there is a very low potential for noncarcinogenic effects. Acceptable levels for carcinogenic and noncarcinogenic effects that would achieve the performance standards in IDAPA 16.01.05.009 (40 CFR 265.111 and 265.197) would be identified in the State of Idaho approved Closure Plan.

4.3.5.3 Closure Meeting Landfill Standards. If a tank system owner or operator demonstrates to the regulator that the tank system cannot be practically decontaminated at the time of closure, then the system must be closed as a landfill (40 CFR 264/265.310). Closure as a landfill also triggers the permit requirements for the postclosure period (40 CFR 270.1(c)). To consider closure as a landfill, the facility should:

1. Demonstrate clean closure impracticability to the regulator

2. Prepare a landfill closure and postClosure Plan[e]

3. Obtain approval from the agency.

Landfill closure components include the design, installation, and operation of a groundwater monitoring system (40 CFR 264, Subpart F) and a final cover. The groundwater monitoring system is based on the characterization of the hydrogeology and groundwater patterns. Detection monitoring wells would be capable of sampling for the applicable waste constituents.

The landfill cap would be designed to minimize contaminated leachate releases during the postclosure period and the long term. A final cover must:

1. Provide for the long-term minimization of liquids migrating through the closed landfill

2. Function with a minimum of maintenance

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[e] Tank systems lacking secondary containment are required to prepare a Closure Plan as a landfill [40 CFR 265.197(c)].

3. Promote drainage and minimize erosion or abrasion of the final cover

4. Accommodate settling and subsidence so that the cover's integrity is maintained

5. Have a permeability less than or equal to the permeability of any bottom liner or natural soils present.

Several guidance documents on interpreting the regulatory requirements for final covers and on their design are available from EPA.

4.4 NRC Landfill Disposal Requirements

Legislation is being considered that would provide for the regulatory oversight of DOE LLW disposal by the NRC. The current NRC regulatory authority and guidance for oversight of commercial LLW radioactive waste disposal sites (see Appendix B, Section B-2.27) is used to provide guidance in identifying the applicable requirements and regulations that may apply to a DOE facility. However, it is noted that during the development of legislation providing for this DOE oversight by the NRC, these requirements may be modified.

The NRC provides specific procedural requirements and performance objectives for the land disposal of radioactive waste. General safety objectives include:

1. Protection of the general population from radioactivity releases

2. Protection of individuals from inadvertent intrusion

3. Protection of individuals from operations

4. Stability of the site after closure.

The specific requirements and assumptions for an NRC landfill are found in Section 5.

4.5 National Historic Preservation Act

The TFF is potentially eligible for listing in the national register of historic places. Activities associated with the closure would require consultation with Idaho State Historic Preservation Officer and compliance with any substantive requirements identified. This consultation, required by Section 106 of the National Historic Preservation Act, would be conducted before the initiation of any closure activities.

4.6 DOE Regulations

DOE regulations are applicable to the activities associated with the TFF RCRA Closure and potential follow-on tank void uses. Regulations include 10 CFR Part 835, Occupational Radiation Protection; "10 CFR Part 1021," Compliance with the National Environmental Policy Act"; and 10 CFR Part 1022 "Compliance with Floodplains/Wetlands Environmental Review." The requirements and applicable subsections that would impose special design or operational restrictions on the project are identified in Section 5.

4.7 Regulatory Issues and Concerns

Based on a regulatory requirements review, the following issues and concerns with potential impact to the project are identified:

4.7.1 Transfer of Regulatory Responsibility

The transfer of responsibilities between RCRA and CERCLA has been successful at the INEEL as both programs are common to EPA and guidance for transfer has been provided.

ISSUE: The acceptability of the transfer of responsibilities from NRC to CERCLA is unknown.

4.7.2 Floodplain Status

The status of the 100- and 500-year floodplains at the INEEL is undetermined at this time, as final floodplain maps have not been developed. 10 CFR 61.50(a)5 states that "waste disposal shall not take place in a 100-year floodplain, coastal high-hazard area or wetland, as defined in Executive Order 11988, "Floodplain Management Guidelines."

ISSUE: As floodplain maps are not available, it is unknown what impacts the floodplain would have on this site.

4.7.3 Engineered and Maintained Flood Barriers

The TFF may be protected from the 100- and 500-year floods by an engineered barrier, which is a diversion and dike system located near the Radioactive Waste Management Complex (RWMC). This engineered structure has not been analyzed to determine the ability to meet NRC guidance.

ISSUE: Need to determine the ability of the diversion and dike system to withstand impacts (flow, scour, deposition, riverine movement, etc.) over an extended period (500+ years). This requires characterization of this barrier per NRC guidance. See Reg. Guide 1.132, Rev. 1, "Site Investigations for Foundations of Nuclear Power Plants." Barriers used to provide flood mitigation shall be characterized per Reg. Guide 1.132, Rev. 1, "Site Investigations for Foundations of Nuclear Power Plants."

4.7.4 Draft NRC Guidance on Engineered Barriers

The NRC has identified that the relationship between the overall 10 CFR 61 data and design requirements and detailed performance assessment needs are not directly apparent from the existing NRC guidance documents. In response, the NRC has prepared and made available for public comment the draft NUREG-1573, "Branch Technical Position on a Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities."

ISSUE: In review of this draft guidance document, the following issues are identified that would require further analysis:

1. Performance of engineered barriers (Section 3.2 of NUREG-1573). After 500 years, engineered barriers should be assumed to function at levels of performance considerably less than their optimum level and should not be assumed to function long enough to influence the eventual release of long-lived radionuclides.

2. Performance assessment timeframe (Sections 3.2.3 and 3.3 of NUREG-1573). A performance assessment of 10,000 years should be used to demonstrate site suitability and capture the peak dose from the more mobile long-lived radionuclides.

3. Preparations of modeling to predict site and design adequacy (Section 3.1 of NUREG-1573). This includes potential air, ground water, and surface water pathways.

4.7.5 Natural Phenomena Analysis

The NRC regulations identify minimum characteristics that a near surface disposal facility for radioactive waste is required to have (10 CFR 61.50) The regulations identify that a disposal site is to avoid areas with tectonic processes including faulting, folding, seismic activity or volcanism where the frequency could affect the disposal site's ability to meet the performance objectives.

Section 4.6.3 of the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* identified that seismic hazards at the INEEL include the effects from ground shaking and surface deformation (surface faulting, tilting). Based on the seismic history and the geologic conditions, earthquakes greater than magnitude 5.5 (and associated strong ground shaking and surface fault rupture) are not likely to be generated within the Plain. However, moderate to strong ground shaking can affect the INEEL site from earthquakes in the region.

The volcanic activity frequency has been identified in the NRC license for the siting of the TMI-2 Independent Spent Fuel Storage Installation (ISFSI) site, located at ICPP. This study identified that potential basalt lava flows suggest minimum (most conservative) volcanic-recurrence intervals of 10^{-4} to 10^{-5} per year. A probabilistic risk of basalt-lava inundation or intrusion-related ground disturbance is estimated to be $<10^{-5}$ per year for the ISFSI site and other sites on the southern INEEL (Safety Analysis Report for the INEL TMI-2 Independent Spent Fuel Storage Installation, Section 2.6.6, Docket No. 72-20, Rev. 0, Oct. 1996).

ISSUE: Based on the frequency of tectonic processes (seismic activity and volcanism), discussions with the NRC need to occur to clarify the natural resource suitability characteristics, the ability of the disposal site to meet the performance objectives, and identify issues that may preclude defensible modeling and prediction of long-term impacts.

4.7.6 Monitoring System

The NRC requirement to establish a monitoring system that would differentiate between contaminants released from the Class C landfill (tanks) versus other releases (e.g., from CERCLA contaminants) may be impractical.

ISSUE: The CERCLA contaminants, consisting of operational releases and spills from the tank system piping and valves, are located immediately adjacent to the tanks and may "mask" the environmental monitoring program.

4.7.7 CERCLA Coordination

Because of the CERCLA contaminants close proximity to the TFF tanks, the TFF protective cap for compliance with the RCRA Closure to Landfill Standards and NRC near-surface landfill must be designed in coordination with the CERCLA program to ensure long-term protection of human health and the environment.

ISSUE: The site complexity and potential activities (RCRA closure, NRC Landfill) will impact the protective cap design, monitoring system and buffer zone size. Extensive coordination will be required between the respective agencies (NRC, State of Idaho, EPA, and DOE) to avoid duplication, resolve conflicting requirements, and develop a solution that provides long-term protection of human health and the environment.

4.8 References

4-1. Department of Energy, *Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-Level Waste Program*, DOE/ID-10544, October 1996.

5. REQUIREMENTS AND ASSUMPTIONS

This section provides a centralized location for the requirements and assumptions identified and developed during the study. Section 5.1 provides the known regulatory and design requirements associated with the identified activity. Section 5.2 provides a listing of developed assumptions required to accomplish the activity. These requirements and assumptions are grouped into subsections. Each subsection provides information on a particular subject developed during this study. Section 5.2.1 provides the key assumptions.

5.1 Requirements

Applicable design requirements, regulations, consent orders, and legal agreements were reviewed to establish the major requirements affecting TFF Closure. Major requirements were those that bounded the options and costs. Regulatory requirements with small impact to the options or costs are only referenced.

5.1.1 General

The requirements listed within this section are applicable to any closure option presented within this study.

1. Airflow into a tank shall be maintained during closure-related activities that require having an open riser.

   Basis: Airflow into a tank ensures that outside air travels into the tank whenever accesses have been breached. Airflow must be controlled such that air moves from areas of lesser contamination to areas of greater removable contamination – INEEL Radiological Control Manual.

2. Year-round capability to perform TFF RCRA closure and subsequent tank void filling operations shall be provided.

   Basis: Extreme temperature changes, wind, etc. will reduce the time available for closure operations without a weather enclosure. The weather would then dictate the closure progress and could compromise meeting legal completion dates and cause an increase in budget. Using an enclosure eliminates unpredictable weather-related variables in the closure sequence.

3. DOE shall treat all high-level waste currently at the INEEL so that it is ready to be moved out of Idaho for disposal by a target date of 2035.

   Basis: Section C (3) of the Batt Agreement.

4. All personnel working within the TFF boundary shall have the appropriate training required to perform work.

   Basis: INEEL training requirement.

5. No minimum airflow rate into an open riser shall be required.

   Basis: No minimum flow rate requirement exists for airflow into a tank. Flow into a tank will be verified using smoke generators. EDF-TFC-017 and EDF-TFC-18.

6. A Risk Assessment identifying the potential risks to workers from an industrial hygiene and safety standpoint shall be prepared before initiating closure. This Risk Assessment will be done by others.

5.1.2 Regulatory and Environmental

This section summarizes applicable regulatory and environmental requirements identified during the analysis discussed in Section 4.

5.1.2.1 Environmental and Public Safety.

1. The NRC Class C grout placed in the TFF shall be a radioactive, nonhazardous waste.

   Basis: The grout facility shall provide for the LDR treatment or delisting of any RCRA regulated wastes to allow land disposal in the TFF (subject to compliance with RCRA Subtitle D Landfill requirements). Failure to delist and treat the waste to LDRs would require the TFF to meet RCRA Subtitle C (hazardous waste) landfill requirements.

2. Tank cease use shall be defined as:

   a. Lowering the liquid level in the tank to the greatest extent possible by using existing tank transfer equipment

   b. No longer using that tank.

   When this occurs, the tank will meet the "cease use" status required in the April 1992 Consent Order.

   Basis: 1/24/95 Letter to D. R. Rasch, DOE-ID, from O. D. Green, State of Idaho Division of Environmental Quality.

3. Tanks WM-182, WM-183, WM-184, WM-185, and WM-186 and associated vaults shall cease use by March 31, 2009. Tanks WM-180, WM-181, WM-187, WM-188, WM-189, and WM-190 and associated vaults shall cease use by June 30, 2015.

   Basis: Consent Order dated April 1992., Items 6.20 (B)3 and 6.20 (B)5.

4. The TFF shall be RCRA closed.

   Basis: 40 CFR 265, Subpart G, "Closure and Post-Closure" requirements.

5. Waste transfer piping shall be flushed before access by personnel.

   Basis: Knowledge from prior TFF projects. Piping containing waste must be flushed to reduce the radiological waste constituent concentrations before that piping can be opened. This minimizes potential radioactive exposure to personnel.

6. A hazardous waste determination shall be conducted on all newly generated wastes.

   Basis: All solid waste generators are required to determine if their waste is hazardous per 40 CFR 262.11.

5.1.2.2 RCRA Closure

This section lists the RCRA requirements for closing the TFF. General RCRA requirements are as follows:

1. Closure plans shall be based on a stepped approach to determine which of the following RCRA closure methods are achievable:

   a. Total Removal Clean Closure

   b. Risk-Based Clean Closure

   c. Closure to Landfill Standards.

   Basis: Regulatory interpretation of 40 CFR 265.197.

2. Closure plans shall be submitted to the State of Idaho DEQ for the first phase of the ICPP TFF Closure by January 1, 2007 and by January 1, 2013 for the second closure phase.

   Basis: 1/24/95 Letter to D. R. Rasch, DOE-ID, from O. D. Green, State of Idaho Division of Environmental Quality.

3. Tank system closures shall commence 6 months after the cease use dates of 2009 and 2015. Closure would require approximately 9 years for the five pillar-and-panel tanks, and less time than that for the remaining six tanks.

   Basis: 1/24/95 Letter to D. R. Rasch from O. D. Green, State of Idaho Division of Environmental Quality and 10/24/94 Letter to O. Green, State of Idaho Division of Environmental Quality from D. R. Rasch, DOE-ID.

4. Sodium-bearing waste shall be managed as incidental waste.

   Basis: The sodium-bearing waste does not meet the published definition of HLW; however, it meets the published definition of incidental waste (58 CFR 41, March 4, 1993). *Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-Level Waste Program*, DOE/ID-10544. Oct. 1996.

5. Closure performance criteria shall be identified in the Closure Plan approved by the State of Idaho. Closure shall be performed in accordance with this approved plan.

   Basis: 40 CFR 265.197.

5.1.2.2.1 Performance Criteria for Closure to RCRA Landfill Standards—Performance criteria for Closure to RCRA Landfill Standards are identified below.

1. Landfill design, cover, closure care, and postclosure care shall include:

   a. Minimizing long-term liquid migration through a closed landfill

   b. Minimizing maintenance

   c. Promoting drainage and minimizing cover erosion or abrasion

   d. Accommodating subsidence and settling so that the cover's integrity is maintained

   e. Providing a cover permeability less than or equal to the permeability of any bottom liner system or natural subsoil's present.

   Basis: 40 CFR 265.310 and 40 CFR 265.111.

2. **Postclosure Maintenance and Monitoring**—Upon final closure, the owner or operator shall comply with postclosure requirements for maintenance and monitoring, including:

   a. Maintaining the final cover integrity and effectiveness, such as making repairs to the cover to correct the effects of settling, subsidence, erosion, or other events.

   b. Maintaining and monitoring the leak detection system in accordance with 40 CFR 265.301(c)(3)(iv) and (4) and 265.304(b), and complying with all other applicable leak detection system requirements of 40 CFR 265.

   c. Maintaining and monitoring the groundwater monitoring system and complying with all other applicable requirements of 40 CFR 265 Subpart F – Groundwater Monitoring.

   d. Preventing moisture run-on and runoff from eroding or otherwise damaging the final cover.

   e. Protecting and maintaining surveyed benchmarks used in complying with 40 CFR 265.309.

   Basis: 40 CFR 265.310 and 40 CFR 265.117 through 120.

3. **Free Liquid Elimination**—Landfills have special liquid elimination requirements that apply to the TFF. Activities such as flushing pipe contents back to the tank being closed, and heel stabilization shall comply with the requirements concerning free liquids including:

   a. Free liquids shall be eliminated

b. Sorbents used to absorb free liquids shall not be biodegradable.

Basis: 40 CFR 265.314.

4. **Survey Plat**—Closure as a landfill requires submittal of a survey plat to the IDHW and local zoning authority indicating the hazardous waste units location, contents, and dimensions. The survey plat provides important information on closed units in the event that the facility is sold or abandoned. The survey plat must be submitted no later than the submission of each hazardous waste disposal unit closure certification.

Basis: 40 CFR 265.116 and 40 CFR 265.309.

5. **Groundwater Monitoring**—A groundwater monitoring program is required unless the owner can demonstrate that there is a low potential for hazardous waste or hazardous waste constituents migration from the facility. Requirements for a groundwater monitoring system shall include:

a. Installation, operation, and maintenance of a system capable of yielding groundwater samples for analysis.

b. Wells installed hydraulically upgradient from the limit of the waste management area.

c. Samples representative of background groundwater quality in the uppermost aquifer near the facility but not affected by the facility.

d. Wells installed hydraulically downgradient (at least three) at the limit of the waste management area. Their number, locations, and depths must ensure that they immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.

e. Monitoring well construction specifications.

f. Parameters for sampling and analysis and a schedule for reporting.

g. Maintaining records throughout the postclosure period.

Basis: 40 CFR 265.90 through 94.

6. ***Postclosure Care***—Postclosure care shall include groundwater monitoring, reporting (40 CFR 265, Subparts F and N), and maintaining waste containment systems (40 CFR 265, Subpart N). The postclosure period is normally for 30 years after closure is completed but may be extended or shortened by the regulator. Postclosure property use may not disturb the final cover, liners, or other containment or monitoring systems unless such disturbance is necessary for the proposed use or to protect human health and the environment.

Basis: 40 CFR 265.117.

5.1.2.3 Performance Criteria for an NRC Near-Surface Landfill. This section identifies the key requirements for an NRC-licensed near-surface disposal landfill (within 30 meters of the surface) for radioactive waste. One study objective was to place LLW (NRC Class C) waste inside the TFF tanks following closure (subsequent use). Table 5-1 provides general information on Class C waste. Specific class determination requirements are found in 10 CFR 61.55.

Basis: 10 CFR 61.55.

1. **NRC Waste Classification**—The grouted waste disposed in the near-surface landfill shall comply with the NRC classification system limits for LLW based on its potential hazards (Class C as defined in 10 CFR 61.55) and waste form. The radioactive waste disposed of in a near-surface facility shall meet the following conditions:

   a. The radionuclide concentrations in the waste are less than or equal to the limits for Class C LLW as defined in 10 CFR 61.

   b. The waste disposal will not represent a hazard to the public health or safety. A performance evaluation for the HLW and greater than Class C fraction will be required to demonstrate that this requirement can be met.

   c. Calculations based on a material balance or other method, show that the majority of radioactivity will be present in the HLW fraction. This HLW fraction shall be disposed of at a geological repository.

   d. Various separation processes have been considered and the selected process is the most technically and economically feasible.

   Basis: 10 CFR 61.56 and NRC Denial of Petition for Rulemaking, Vol. 58, No 41.

2. **Disposal Site Characteristics**—The NRC regulations identify the minimum characteristics that a disposal site shall have to be acceptable for use as a near surface disposal facility. Criteria used to identify disposal site suitability requirements shall include:

   a. The site can be characterized, modeled, analyzed, and monitored.

   b. Future population growth and land use developments are not likely to affect the disposal facilities ability to meet the performance objectives of an NRC-licensed disposal facility.

   c. Disposal site is well-drained and free of flooding or frequent ponding areas.

   d. Disposal shall not occur in a 100-year floodplain or wetland.

   e. Avoidance of areas with known natural resources, which, if exploited, would result in failure to meet performance objectives.

   f. Upstream drainage areas shall be minimized to decrease the runoff amount that could erode or inundate the waste.

Table 5-1. General radionuclide information for NRC Class waste.

Radionuclide	Maximum Concentration in curies/m^3		
	Class A	Class B	Class C
Total of all nuclides with less than 5 year half-life	700	(a)	(a)
H-3	40	(a)	(a)
Co-60	700	(a)	(a)
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7,000
Sr-90	0.04	150	7,000
Cs-137	1	44	4,600

a. There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transpiration, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in this table determine the waste to be Class C independent of these nuclides.

g. Water table depth is sufficient so that groundwater intrusion will not occur.

h. Hydrogeologic unit does not discharge groundwater to the surface within the disposal site.

i. Avoidance of areas with tectonic processes such as faulting, folding, seismic activity, or volcanism with such frequency and extent so as to affect the disposal site's ability to meet the performance objectives or that may preclude defensible modeling and predicting long-term impacts.

j. Avoidance of areas with surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering that could affect the disposal site's ability to meet the performance objectives or that may preclude defensible modeling and predicting long-term impacts.

k. Avoidance of areas with nearby facilities or activities that could adversely impact the disposal site's ability to meet the performance objectives or significantly mask the environmental monitoring program.

Basis: 10 CFR 61.50 a(1).

3. **Waste and Site Stabilization**—The land disposal site shall be stabilized so that water access to the waste is minimized once that waste has been emplaced and covered. This ensures that radionuclide migration is minimized, long-term active maintenance can be avoided, and potential exposure to intruders is reduced.

   Basis: 10 CFR 61.7a(2).

4. **Site Control**—Institutional site control, for up to 100 years, shall occur to ensure that no occupation or improper use of the site occurs.

   Basis: 10 CFR 61.7a(4).

5. **Intruder Barriers**—Intruder barriers having an effective life of 500+ years shall be installed. The barrier type shall depend on the hazards posed by the radionuclides and shall be designed so that the site does not pose an unacceptable hazard to an intruder or public health and safety.

   Basis: 10 CFR 61.7a(4).

6. **Near-Surface Landfill Siting**—A land disposal facility shall be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established by the performance objectives as follows:

   a. Health protective limitations on radioactive material concentrations that may be released to the general environment in groundwater, surface water, air, soil, plants, or animals shall not result in an annual dose exceeding an equivalent of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public.[a]

   b. Land disposal facility design, operation, and closure shall ensure protection of any individual inadvertently intruding into and occupying the disposal site or contacting the waste at any time after active disposal site institutional controls are removed.

   c. Radiation protection standards including radiation exposure limits shall be as low as is reasonably achievable.

   Basis: 10 CFR 61.41 through 61.44.

7. **Site Design**—The disposal site design for land disposal requirements shall include:

   a. Site design features shall be directed toward long-term isolation and avoiding the need for continuing active maintenance after site closure.

   b. The disposal site design and operation shall be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that provides reasonable assurance that the NRC performance objectives will be met.

   c. The disposal site shall be designed to complement and improve, where appropriate, the ability of the disposal site's natural characteristics to ensure that the 10 CFR 61.51, Subpart C performance objectives will be met.

   d. Covers shall be designed to minimize water infiltration to the extent practicable, to direct percolating or surface water away from the disposed waste, and to resist degradation by surface geologic processes and biotic activity.

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[a] Note: For purposes of the NRC evaluation, it is anticipated that the NRC would have the potential dose to the public measured at the nearest unrestricted boundary (Highway 20). Previously, the dose to a member of the public, the maximally exposed individual (MEI), was measured at the nearest location where a person could live and receive a maximum dose, which is the INEEL boundary.

e. Surface features shall direct surface water drainage away from disposal units at velocities and gradients that will not result in erosion that requires ongoing and future active maintenance.

f. The disposal site shall be designed to minimize to the extent practicable, contact of water with waste during storage, contact of standing water with waste during disposal, and contact of percolating or standing water with waste after disposal.

Basis: 10 CFR 61.51 "Disposal Site Design for Land Disposal."

8. **Operational Closure**—The operation and closure of a Class C waste disposal site shall:

a. Have the Class C waste disposed of so that the top of the waste is a minimum of 5 meters (16.4 feet) below the top surface of the cover, or must be disposed of with intruder barriers that are designed to protect against an inadvertent intrusion for at least 500 years.

b. Dispose of wastes such that voids are minimized or filled.

c. Place and cover wastes so as to limit the radiation dose rate.

d. Have each disposal unit's boundary and location surveyed and marked.

e. Have a buffer zone maintained between the waste and the disposal site boundary and beneath the waste.

f. Have a buffer zone sized to carry out environmental monitoring and to conduct mitigative measures.

g. Have an environmental monitoring system capable of providing an early warning of radionuclide operational and postoperational releases from the disposal site before they leave the site boundary.

Basis: 10 CFR 61.52.

9. **Environmental Monitoring**—Environmental monitoring is required for an NRC near-surface landfill and shall include:

a. A preoperational monitoring program that provides basic environmental data on the disposal site characteristics such as ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology.

b. Plans for taking corrective measures if radionuclide migration indicates that the NRC performance objectives may not be met.

c. Maintaining a monitoring program during the land disposal facility site construction and operation.

d. A monitoring system capable of providing early warning of radionuclide releases from the disposal site before they leave the site boundary.

e. Maintain a monitoring system based on the operating history and the closure and stabilization of the disposal site after the disposal site is closed.

Basis: 10 CRF 61.53 - Measurements and observations must be made and recorded to provide data to evaluate the potential health and environmental impacts during both the construction and the operation of the facility and to enable the evaluation of long-term effects and the need for mitigative measures.

10. **Alternatives to NRC Designs and Operations**—Alternate designs and operations can be used if approved by the NRC.

Basis: 10 CFR 61.54 - The NRC may, upon request or on its own initiative, authorize provisions other than those set forth in 10 CFR 61.51 through 61.53 for the segregation and disposal of waste and for the design and operation of a land disposal facility on a specific basis. This can be done if the NRC finds reasonable assurance of compliance with the performance objectives of 10 CFR 61, Subpart C.

11. **General Waste Requirements**—The following requirements are intended to facilitate waste handling at the disposal site and provide protection of personnel health and safety at the disposal site:

a. Liquid wastes, or wastes containing liquid, shall be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable. Liquid inside a container shall not exceed 1% of the waste volume when the waste is placed in a disposal container designed to ensure stability, or 0.5% of the waste volume for waste processed to a stable form, not withstanding the provisions in (b) and (c) below.

b. Liquid waste shall be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

c. Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

d. Waste shall not be packaged for disposal in cardboard or fiberboard boxes.

e. Waste shall not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

f. Waste shall not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged as identified below.

g. Waste shall not be pyrophoric.

h. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

i. Waste in a gaseous form shall be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C (68°F). Total activity must not exceed 100 curies per container.

j. Waste containing hazardous, biological, pathogenic, or infectious material shall be treated to reduce to the maximum extent practicable the potential hazard from the nonradiological materials.

k. Waste shall have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. The waste form can provide structural stability by itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

l. Void spaces within the waste and between the waste and its package shall be reduced to the extent practicable.

Basis: 10 CFR 61.56.

12. **Disposal Site Stability**—Specific design needs for an NRC near-surface disposal site include the ability to achieve long-term disposal site stability and eliminate, to the extent practicable, the need for ongoing active maintenance following closure so that only surveillance, monitoring, or minor custodial care are required. Design features shall include:

a. A structural performance monitoring system to allow verification of important design assumptions and confirmation that the structure is stable and performing as designed.

b. Filter and drainage systems that conservatively handle infiltration and subsurface waters before the water contacts waste and also provide for safe collection and removal of any liquid flows and the design is consistent with Sections 2.7.1, and 2.7.2.1 through 2.7.2.6 of NUREG/CR-54041.

Basis: NUREG 1200.

13. **Design for Flood Phenomena**—The near-surface landfill's design shall use the probable maximum flood (PMF) and probable maximum precipitation (PMP) as the acceptable bases for the flood protection feature designs when wastes are not covered or protected. Consideration shall be given for flood control features capable of preventing erosion and disposal unit flooding or designed so that inundation does not result in the waste releases from the disposed area.

Basis: NUREG 1200.

14. **Design for Natural Disaster Phenomena**—The near-surface landfill's design shall provide a description of the construction methods for individual disposal units, backfilling techniques, void space elimination, and sequence for closure. Information shall be included on the use of any concrete and steel structural materials in the facility, including the analytical procedures used in the design and performance of the facility. Information shall be provided for analysis of loads and load combinations, such as dead and live loads due to:

    a. Lateral and vertical pressures of incidental liquids

    b. Loads due to lateral earth pressures

    c. Thermal loads from temperature differences

    d. Loads generated by design wind pressure

    e. Loads generated by a design basis earthquake.[b]

    Basis: NUREG 1200.

5.1.2.4 DOE Regulations. DOE regulations are applicable to RCRA Closure activities. Requirements and applicable subsections that would impose special design or operational restrictions include:

5.1.2.4.1 Occupational Radiation Protection—Federal regulations establish radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from DOE conducted activities. All sections of 10 CFR Part 835 are applicable to all closure and subsequent use activities covered within this study. However, specific attention during activity planning and implementation shall be directed to the following:

1. **Occupational Radiation Exposure Limits**—Occupational exposure to general employees resulting from DOE activities shall be controlled so the following annual limits are not exceeded:

    a. Total effective dose equivalent of 5 Rem (0.05 sievert)

    b. Sum of the deep dose equivalent for external exposures and the committed dose equivalent to any organ or tissue other than the lens of the eye of 50 Rem (0.5 sievert)

    c. Eye lens dose equivalent of 15 Rem (0.15 sievert)

    d. Shallow dose equivalent of 50 Rem (0.5 sievert) to the skin or to any extremity.

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[b] An NRC design basis earthquake is not calculated in the same manner as a DOE design basis earthquake.

Basis: 10 CFR Part 835.202, "Occupational Exposure Limits for General Employees."

2. **Individual and Area Monitoring**—Monitoring of individuals and areas shall be performed to:

   a. Demonstrate compliance with the regulations in Parts 835.401 through 404.

   b. Document radiological conditions in the workplace.

   c. Detect changes in radiological conditions.

   d. Detect the gradual radioactive material buildup in the workplace.

   e. Verify engineering and process control effectiveness for containing radioactive material and reducing radiation exposure.

   f. Area monitoring in the workplace shall be routinely performed, as necessary, to identify and control potential sources of personnel exposure to radiation and/or radioactive material.

   g. Instruments used for monitoring and contamination control shall be periodically maintained and calibrated on an established frequency of at least once per year; appropriate for the type(s), levels, and radiation energy(ies) encountered; appropriate for existing environmental conditions; routinely tested for operability.

   Basis: 10 CFR Part 835.401 through 404.

3. **Radiation Exposure Management**—Measures shall be taken to maintain radiation exposure in controlled areas as low as is reasonably achievable (ALARA) through facility and equipment design, administrative control, and an approved radiation protection program. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls and procedural requirements shall be employed only as supplemental methods to control radiation exposure.

   Basis: General design and operational requirements identified in 10 CFR 835, Subpart F, "Entry Control Program," and 10 CFR 835, Subpart K, "Design and Control."

5.1.2.5 National Environmental Policy Act Compliance—DOE shall coordinate its National Environmental Policy Act (NEPA) review with its decision-making. DOE will make a decision, based on the NEPA analysis, as to the closure method to be submitted to the State of Idaho for approval. Decisions will also be made about subsequent TFF void uses.

Basis: 10 CFR Part 1021.

5.1.2.6 Floodplains/Wetlands Environmental Review Compliance—Closure and landfill activities shall:

a. Avoid to the extent possible the long- and short-term adverse impacts associated with wetland destruction and the occupancy and modification of floodplains and wetlands.

b. Avoid direct and indirect support of floodplain and wetland development wherever there is a practicable alternative.

Basis: 10 CFR Part 1022.

5.1.2.7 CERCLA Soil Coordination. CERCLA soil coordination shall provide that, subject to approval from the CERCLA Operable Unit manager, soils dug from CERLCA sites within the ICPP fence, such as CPP-88 or EOC 25, can be returned to the excavations without generating waste. Storage of this soil, before redeposition, may require containerization or containment due to health/safety concerns.

Basis: Regulatory interpretation of CERCLA requirements documented in 7/10/97 conference call with LMITCO, DOE-ID, EPA, and IDHW/DEQ. Documented by 7/14/97 e-mail from Talley Jenkins, DOE-ID. EDF-TFC-044

5.1.3 Site Preparation

1. Facilities shall be designed to facilitate safe deactivation, decommissioning, and decontamination at end of life.

   Basis: DOE Order 420.1, Section 4.1.1.2, "Design Requirements."

2. DOE contractors shall develop, implement, and maintain a comprehensive fire protection program for facilities.

   Basis: DOE Order 420.1, Section 4.2.2, "Fire Protection Design Requirements."

5.1.3.1 Utilities

1. Utilities, feeders, and mains shall be sized to accommodate 125% of calculated load demands.

   Basis: Future capacity needs may be more than projected. Oversizing utilities, feeders, and mains should minimize costs associated with increases above calculated load demands.

5.1.3.2 Structural

1. During and/or after site preparation activities, the total combined weight of vehicles, equipment, and personnel in a specified zone shall not exceed the structural load limit as specified in CPP-MCP-P7.5-A1.

   Basis: Weight exceeding those values specified in the ICPP MCP could damage the vaults. Vault damage could then result in tank damage. Restricting the zone weight ensures that the vaults will not be damaged.

2. Support buildings, such as control trailers and storage bunkers, shall be located north of the TFF in Zone D or other areas capable of supporting the additional weight without compromising tank vault integrity.

   Basis: Placing support buildings in areas close to the tanks and vaults (Zones A, B, and C) would limit the amount of additional equipment weight that could be placed in the same zone as the building(s). Therefore, buildings will be placed in areas (such as Zone D) capable of supporting more weight than areas near vaults.

3. The requirements and restrictions for loads in the TFF are listed below:

   a. Vehicle loading in A subzones shall not be greater than 30,000 lb unless otherwise approved.

   b. Vehicle loading in B subzones shall not be greater than 30,000 lb unless otherwise approved.

   c. Vehicle loading in C subzones shall not be greater than 71,000 lb unless otherwise approved.

   d. Vehicle loading in D subzones shall not be greater than 200,000 lb unless otherwise approved.

   e. Vehicles shall travel under 2.5 mph in TFF zones to prevent amplifying wheel pressure upon the soil.

   f. Vehicle loading requirements are for dry soil conditions. Vehicles shall not be allowed in these zones during saturated soil conditions.

   g. Maximum lift loads for all cranes shall be 12,000 lb.

   h. Lift loads on cranes shall be kept low when moved over the TFF.

   i. Nonvehicle loads shall be less than 1,000 lb per zone.

   Basis: CPP-MCP-P7.5-A1.

5.1.3.3 Equipment

1. Equipment used inside a tank shall be designed to:

   a. Withstand chemical corrosion and radiation degradation under normal operating conditions or shall allow the affected equipment parts to be replaced with minimal effort and cost.

   b. Minimize the amount of decontamination work required.

   c. Operate through existing and new risers.

   d. Minimize the possibility of damage to the TFF tanks due to equipment failure.

Basis: Engineering judgement. This will minimize project cost and duration. Systems will be designed to operate in the anticipated environment. Designing for decontamination ease will reduce the work required to clean equipment and should reduce personnel exposures. Tank damage could jeopardize that containment by allowing materials to enter and leave the tank barrier.

2. Equipment shall be designed to meet weight loading restrictions in the TFF.

   Basis: Meeting equipment weight restrictions is required by CPP-MCP-P7.5-A1.

3. Equipment inserted into any tank riser shall be sealed at the equipment to riser interface.

   Basis: Engineering judgement. Providing sealed joints will minimize the possibility of emissions to the environment.

4. Equipment designed for installation into an existing 12-inch tank riser shall have a maximum outer diameter of 10.5 inches.

   Basis: Previous TFF riser measurements and process work has shown that anything larger in diameter will not fit down some of the existing 12-inch risers.

5.1.3.3.1 Temporary Vessel Off Gas (VOG) System

1. High-efficiency particulate air (HEPA) filter housings (skids) shall require shielding.

   Basis: Shielding will minimize personnel radiation exposure from contamination trapped in the HEPA filter.

2. Demisters and superheaters or equivalent equipment shall be used on the temporary VOG system.

   Basis: Provisions must be made to prevent condensate from accumulating in the HEPA filters. EDF-TFC-018.

3. The VOG piping shall be stainless steel.

   Basis: Stainless steel piping will be required due to the presence of nitric fumes and/or condensate. EDF-TFC-017.

5.1.3.3.2 Tank Washing System

1. Washing system shall be designed to access all inside tank surfaces (including the dome, walls, and floor) from the centermost riser.

   Basis: Cleaning operations completed from a single centralized riser will limit the total number of wash equipment design configurations and the total number of equipment installations into the tank, which should then reduce overall process costs.

5.1.3.3.3 Video System

1. Video and lighting equipment shall be installed in the tank and vaults.

   Basis: Video and lighting equipment allows remote operation inside the tank or vault and provides closure step verification.

2. Video and lighting equipment shall be designed to withstand direct vault or void fluid contact during use.

   Basis: Engineering judgement. Video equipment requires visual clarity and can create large amounts of heat. This requires a system designed to eliminate failures caused by the liquid contents coating the video lens or lighting failures caused by large temperature changes when fluid contacts the lights.

5.1.3.3.4 Remote Heel Sampling System

1. A remote sampling device shall be obtained or developed, and tested for use in heel constituent characterization activities.

2. Basis: Engineering judgement. A system is required to safely remove representative heel samples. These samples are required to establish the heel constituents (i.e., pH, hazardous waste concentrations, and radioactive waste concentrations) before, during, and after heel closure activities.

5.1.3.4 Enclosures

1. Large Area Containment structures shall be designed per MCP-198.

   Basis: Company Policy per MCP-198.

2. HEPA filtered exhaust systems shall be used to maintain a negative pressure within the "Large Area Containments" only after the tank system has been isolated from the TFF. These exhaust systems will discharge within the TFF enclosure.

   Basis: A negative pressure shall be maintained within Large Area Containments to minimize outward releases of radioactive and hazardous materials into the enclosure. EDF-TFC-030.

3. Enclosures and systems shall be designed, constructed, and operated to withstand the effects of natural phenomena as necessary to ensure that confinement of hazardous material, the operation of essential facilities, the protection of government property, and the protection of life safety for occupants of DOE buildings. Furthermore, the seismic requirements of Executive Order 12699 shall be addressed.

   Basis: DOE Order 420.1, Section 4.4.2, "Natural Phenomena Mitigation Design Requirements."

4. Double containment will be required during excavation activities.

Basis: Double containment is a conservative assumption for costing and planning purposes for Total Removal Clean Closure based on the requirements defined in DOE Order 6430.1A, "Special Facilities, Irradiated Fissile Material Storage Facilities, and Non-Reactor Nuclear Facilities." DOE 6430.1A has been cancelled, but will remain binding at the INEEL under the LMITCO contract. The LMITCO contract will no longer be in effect when the TFF Closure takes place. DOE Order 420.1, Section 4.1.1.2 replaces DOE Order 6430.1A and states: "All nuclear facilities with uncontained radioactive materials (as opposed to material contained within drums, grout, and vitrified materials) shall have means to confine them. Such confinement will act to minimize the spread of radioactive materials and the release of radioactive materials in facility effluents during normal operations and potential accidents. For a specific nuclear facility, the number and arrangement of confinement barriers and their required characteristics shall be determined on a case-by-case basis. Engineering evaluations, trade-offs, and experience shall be used to develop practical designs that achieve confinement system objectives." Because of the alpha contamination present in the TFF, engineering judgement leads to the assumption that double containment would still be necessary under this order to minimize the spread of radioactive materials.

5.1.4 Total Removal Clean Closure

1. Uncontaminated solid waste shall be sent to the INEEL Landfill Complex as industrial, noncompactible, nonconditional waste.

   Basis: Idaho National Engineering and Environmental Laboratory Reusable Property, Recyclable Materials, and Waste Acceptance Criteria (RRWAC), DOE/ID-10381, February 1997. EDF-TFC-015.

2. Uncontaminated solid waste shall be sent to the INEEL Landfill Complex in DOT 7A Type A D&D Bins.

   Basis: INEEL Reusable Property, Recyclable Materials, and Waste Acceptance Criteria (RRWAC), DOE/ID-10381, February 1997, states that uncontaminated solid waste 'must be transported in equipment that is designed and constructed to be readily emptied and is kept clean" - (DOE/ID-10381, Rev. 6, February 14, 1997, Section 4.3.1). The D&D bins are good candidates for this and are historically used by the D&D group for similar work.

5.1.5 RCRA Closure to Landfill Standards

5.1.5.1 Tank Isolation

1. Valve boxes, condenser pits, control pits, relief valve pits, etc., shall be accessed by flushing the waste transfer piping, installing a containment enclosure, obtaining a complete line outage, installing appropriate shielding, wearing full anti-C acid suits, and providing full-time radiological control technician (RCT) coverage.

   Basis: Required by previous TFF construction projects. This minimizes personnel exposure and possible contamination.

2. Utility and instrumentation lines going to each tank shall be cut and capped to prevent water from entering the tanks or vaults.

   Basis: Utility and nonwaste piping have not contained waste and do not require decontamination efforts, but still require capping to prevent water from entering the tank or vault void spaces.

5.1.5.2 Heel Stabilization

1. The compressive strength of the heel solidification grout shall be a minimum of 500 psi to support the weight of the material placed above it.

   Basis: The 500 psi compressive strength is recommended by the NRC in the paper "Technical Position on Waste Forms," January 1991.

2. Heel pH shall be 0.5 to 2.0 before heel grouting occurs.

   Basis: Laboratory experiments with 3-way grout (equal parts of Portland cement, blast furnace slag, and fly ash) indicate that the heel pH must be in this range to achieve a structurally stable grout. EDF-TFC-026.

5.1.5.3 Vault & Tank Void Management

1. Grout mixture shall be pumpable.

   Basis: The restrictive weight loading within the TFF requires that the grout be pumped to a tank or vault for placement.

2. Void filling grout shall be designed to be self-leveling.

   Basis: Self-leveling allows grout placement to occur using limited void access points and without special consideration for voids remaining within the pour.

3. Void filling grout shall be designed to provide enough structural strength to support its own weight and other structural loads.

   Basis: Providing sufficient structural strength minimizes chances of premature material degradation and will aid in supporting the stainless steel containment tank.

4. Void filling grout shall be designed to minimize shrinkage.

   Basis: Minimizing shrinkage will reduce the gap between the grout and the tank or vault walls.

5. Void filling grout shall be designed to minimize air pocket formation.

   Basis: Reducing air pocket amounts maximizes the amount of fill material and provides a more stable leach resistant grout matrix.

6. Void filling grout shall be designed to minimize bleed water.

   Basis: Minimizing bleed water minimizes the amount of free liquid that would be left on top of the cured grout. This liquid would then require additional drying equipment.

5.1.5.3.1 Vault Void Management

1. A passive HEPA filter system shall be connected to a vault riser during void filling operations.

   Basis: HEPA filters will capture any airborne contamination that could be released due to vault temperature fluctuations or void filling operations. EDF-TFC-030.

2. Vaults are ancillary equipment to a tank system and must be decontaminated and closed as part of the tank system.

   Basis: Tank closure 40 CFR 265.197 and 260.10; Void filling 40 CFR 265.111 and 265.310.

3. Tanks used as an NRC near-surface landfill shall have four lances placed into the vault void annulus.

   Basis: Engineering judgement. Lances will provide ability for future tank monitoring as required by the NRC regulations.

4. One to four new vault access holes shall be drilled through the vault roof.

   Basis: Additional access holes will be required to ensure equal grout distribution between the vault and tank wall during grout pouring operations.

5.1.5.3.2 Tank Void Management

1. Void filling grout shall be designed to minimize leaching.

   Basis: Low leach rates will minimize waste constituent migration.

5.1.6 Radiological Protection and Controls

The requirements (controls and actions) listed in this section are based on 10 CFR Part 835, "Occupational Radiation Protection," and LMITCO Manual 15A, "INEEL Radiological Control Manual" (IRCM).

1. Radiation exposure shall be commensurate with the activity performed and shall include plans and measures for applying the "as low as reasonably achievable" (ALARA) process to occupational exposure levels.

   a. The annual administrative control level for the INEEL is 1,500 mrem to the whole body. (IRCM, Art. 211.2.b)

b. Radiation exposure levels shall be established that are challenging and achievable. This value shall be dependent upon the number of workers needed to accomplish the work, the person-hours required, and the radiation field in the work area. (IRCM – Art. 211.3).

c. Normally, administrative controls and procedure requirements shall only be employed as supplementary to physical design features (e.g. confinement, venting, shielding, and remote handling). However for specific activities where the use of physical design features are demonstrated to be impractical, administrative controls and procedures shall be used to maintain exposure ALARA. (§835.101.c and §835.1001.a-b).

d. Technical requirements for work conduct shall incorporate radiological criteria to ensure safety and maintain radiation exposures relative to ALARA. This shall be applied to tasks such as construction, modifications, operations, maintenance, and decommissioning. (10 CFR 835.101.c).

Basis: 10 CFR 835.101, 10 CFR 835.1001, 10 CFR 835.1003, and IRCM. (IRCM, Art. 211.3).

2. Contamination areas shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable contamination levels. (10 CFR 835.404.c.2).

a. Solid barriers should be used to enclose contamination areas wherever practicable. (IRCM - Art. 337.1)

b. Control and direct airflow from areas of lesser to greater removable contamination. (IRCM - Art. 337.3)

c. Use engineering controls and containment devices such as glovebags, gloveboxes, and tents. (IRCM - Art. 337.4)

d. Appropriate monitoring shall be performed to detect and prevent contamination from being spread by individuals exiting radiological areas established to control removable contamination and/or airborne radioactivity. (10 CFR 835.404.f).

Basis: 10 CFR 835.404, and IRCM.

3. Radiological work activities shall be conducted as specified by the controlling technical work document and Radiological Work Permit.

Basis: IRCM – Art. 341.1.

4. Radiological Worker II training shall be required for unescorted entry into the TFF during closure activities.

5. A remote sampling device shall be used to characterize each tank heel.

Basis: IRCM – Art. 312.4.c.

6. A shielded transport cask shall be used to move a characterization sample from the TFF to the Remote Analytical Laboratory (RAL) for analysis.

   Basis: IRCM – Art. 312.4.g.

7. The allowable maximum dose rate in the access hatch working area shall be 100 mrem/hr while open and 5 mrem/hr when closed.

   Basis: Meets applicable radiological requirements and minimizes exposure to employees.

5.2 Assumptions

Assumptions have been developed that are needed to accomplish the activities identified within the report. These assumptions with basis are listed below.

5.2.1 Key Assumptions

Key assumptions are those identified and developed during the study that affect the feasibility or are fundamental to the approach taken to close the CSSF. These key assumptions are also listed in the appropriate sections.

1. The NRC Class C grout placed in the TFF shall be a radioactive, nonhazardous waste.

   Basis: The grout facility should provide for the LDR treatment or delisting of any RCRA regulated wastes to allow land disposal in the TFF (subject to compliance with RCRA Subtitle D Landfill requirements). Failure to delist and treat the waste to LDRs would require the CSSF to meet RCRA Subtitle C (hazardous waste) landfill requirements.

2. The State of Idaho will accept closure to Risk-Based Closure Standards or, if demonstrated to be impractical, to Landfill Standards.

   Basis: 40 CFR 265.

3. Responsibility for capping, monitoring, and long-term maintenance will be transferred to CERCLA.

   Basis: Transfer of regulatory responsibilities is consistent with the EPA Memorandum titled, "Coordination Between RCRA Corrective Action and Closure and CERCLA Site Activities," Steve Herman and Elliot Laws, September 24, 1996. This identifies the option of crafting CERCLA or RCRA decision documents so that cleanup responsibilities are divided. When units or areas deferred from RCRA to CERCLA, RCRA permits or orders can reference the CERCLA cleanup process and state that complying with the terms of the CERCLA requirements would satisfy the requirements of RCRA. This deferral must be agreeable to the regulatory agencies (State of Idaho and EPA).

4. DOE shall treat all HLW currently at the INEEL so that it is ready to be moved out of Idaho for disposal by a target date of 2035.

   Basis: Section C (3) of the Batt Agreement.

5. Liquid waste handling facilities will be available to process liquid waste produced during closure activities.

   Basis: Liquid waste, such as the heels, removed from the tanks must be processed or stored so that closure activities can proceed on the tank being worked.

5.2.2 General

1. RCRA Closure Plan will only include 11 of 19 TFF Tanks (WM-180 through WM-190).

   Basis: The other tanks either meet RCRA standards or are already out of service. The 11 tanks currently in use are non-RCRA compliant.

2. The 18,400-gallon tanks will be closed with the PEWE

   Basis: Engineering judgement. These tanks are integral to the PEWE process and as such should be closed with the PEWE.

3. The 30,000-gallon tanks will be closed at a future date to be identified.

   Basis: Engineering judgement. These tanks were not part of this study, but will be subject to closure. The schedule for closure of these tanks will be subject to negotiation with the State of Idaho.

4. Grout lifts of 2 feet will be used to fill the tank and vault, (18 inches for the first lift in the vault), and voids unless stated otherwise in a specific section.

   Basis: Engineering judgement; Grout analysis conducted for the Waste Calcining Facility (WCF) indicates that grout lifts can be between 2 and 4 feet and still maintain grout structural integrity. Using 2-foot lifts is conservative from both cost and design standpoints. EDF-TFC-033 and EDF-TFC-024.

5. Grout lift curing will take no longer than 7 days before another grout layer can be poured.

   Basis: Grout lift depth analysis. EDF-TFC-033.

6. Grout mixture quality will be tested and qualified using an approved test plan before use inside a tank.

   Basis: Testing inside the vaults and tanks would be very difficult if not impossible. If in situ testing were possible it would be very time consuming and costly. For these reasons, testing will occur before using the actual grout. The grout used will have enough prior laboratory testing to ensure conformance to quality standards developed for that grout. Grout mix quality will be used to establish comparable leachability, coherence, and strength values.

7. Grout will be formulated to minimize bleed water.

Basis: Regulations require no free liquids. Formulating a low bleed water grout will reduce additional work required to absorb or remove the bleed water.

8. Tank risers will be able to accommodate required tank closure equipment simultaneously.

   Basis: Closure processes require equipment in multiple risers of the same tank to facilitate closure operations.

9. Utilities (electrical, water, air, and steam) that support TFF Closure will be supplied by the Tank Farm Closure Project; ICPP will not provide utilities for TFF Closure.

   Basis: Utility requirements for TFF Closure have not yet been defined. To bound the costs, it is assumed that ICPP utility systems will not be able to meet the TFF Closure Project demands and that the project will be responsible for supplying electrical, water, air, and steam. Use of existing utilities will be made wherever possible but is beyond the identified work scope.

10. Any supplemental VOG system will be piped to the existing stack and conform to existing permitting criteria.

    Basis: This will allow compliance with existing air permits and reduce the scale of any new permit required for closure operations that can not be tied into the existing stack.

11. Normal TFF operations will not be interrupted by TFF Closure activities, except for outages to isolate the tank system being closed.

    Basis: Engineering judgement. It is expected that most closure work can be accomplished with little impact to TFF operations.

12. Liquid waste handling facilities will be available to process liquid waste produced during closure activities.

    Basis: Liquid waste, such as the heels, removed from the tanks must be processed or stored so that closure activities can proceed on the tank being worked.

13. RCRA tank closure and void filling activities will have separate equipment.

    Basis: Engineering judgement. Current work indicates that scheduling and physical requirements will be different.

14. A portable grout batch plant will be available at a site on the INEEL.

    Basis: Engineering judgement. A site should be available for grout production. This will minimize transportation requirements and associated impacts.

15. Clean grout will arrive at TFF via "Ready Mix" cement trucks.

    Basis: Grout is commonly transported via truck to a construction site.

16. Volatile organic compound (VOC) sampling will be done before heel pH adjustment and/or removal.

    Basis: Engineering judgement; There is currently no definitive data as to the concentration of VOCs contained in the tanks-only sampling for VOCs that has been done involved steam jetting the air out of the tanks and then sampling for VOCs, thus diluting and/or destroying the results.

17. A new cathodic protection system will not be required. Reconnecting jumpers to the existing cathodic protection system will be sufficient.

    Basis: Engineering judgement; The TFF has a cathodic protection system in place.

18. All hazardous and radioactive waste shipped outside of the INEEL will comply with Department of Transportation (DOT) packaging requirements.

    Basis: DOT regulations for the transportation of waste off-Site.

19. The TFF grade level is 4,917 feet.

    Basis: Engineering judgement. Different "grade levels" have been used in the past for the ICPP TFF. This grade level elevation corresponds to the elevation at the bottom of the Radiation Control Building (CPP-630) and will be used for the purposes of this study. Reference Drawing 055315.

20. The tank walls will be washed one time using water to remove the bulk of the tank residue off the tank walls before any heel pH adjustments have occurred.

    Basis: Engineering judgement. A bound was required to provide cost and schedule estimates. The removed wall residue will be mixed with the heel being removed during the pH adjustment flushes.

21. Three water flushes will be required to bring the tank heel pH into acceptable grouting range.

    Basis: Calculations indicate that the heel pH will be around 2.0 after approximately two to three heel flushings. EDF-TFC-031.

22. The pH adjustment flushes required to bring the tank heel to an acceptable pH will have a secondary benefit of removing waste residue from the tank.

    Basis: Engineering judgement. The pH adjustment activity will remove tank residue, thereby lowering the waste residue concentration left in the tank. This also reduces the volume and concentration of residue requiring removal during RBCC washing activities.

5.2.3 Regulatory and Environmental

1. The State of Idaho will accept RCRA Closure as tank isolation, heel stabilization, and vault void filling as identified in Section 2 of this study.

Basis: This is based on the developed options. Closure as defined within this report requires these basic steps.

2. The annulus between the tank and the vault will be filled with a clean grout.

   Basis: Filling the annulus with this grout type will allow future tank void use as a waste storage location and eliminate current load design limitations. This minimizes the chance of subsidence while the tank void is empty and provides a RCRA cap.

3. The heel remaining in the tanks after washing and heel reduction processes will meet the NRC incidental waste criteria. As the remaining heel would not be an HLW, they may be left in place.

   Basis: Engineering judgement. Residual material will meet the requirement for Class C incidental waste per Section 4.1.1.

4. Long-term postclosure management will be handed over to CERCLA to handle as part of the post-ROD maintenance and monitoring requirements for ICPP if the TFF is closed as a RCRA landfill.

   Basis: The CERCLA and RCRA programs are intended to result in solutions for site decontamination, remediation, and monitoring that are protective of human health and the environment. Where possible, handoff from one program to another is encouraged to avoid duplication of effort. Since the CERCLA program will be conducting a comprehensive monitoring program at ICPP, a transfer of the monitoring for this activity to CERCLA is appropriate. CERCLA has a process to update an ROD to incorporate or reflect new information such as monitoring a RCRA Closure activity at a CERCLA site.

5. Option 2. Risk-Based Clean Closure (RBCC); LLW Fill – The RCRA closure portion of this option will be considered complete after:

   a. Tank system has been isolated

   b. Baseline tank heel and vault contaminant characterization has been conducted

   c. Iterative tank decontamination has been conducted

   d. Iterative vault decontamination has been conducted

   e. Contamination characterization has been conducted

   f. Risk assessment criteria have been achieved based on characterization results

   g. Tank heel has been grouted.

   NOTE: Tank heel grouting will be done as a best management practice.

   h. Vault void has been grouted.

Filling the tank voids with an LLW grout meeting NRC Class C limits will be subject to NRC Near-Surface Radioactive Waste Landfill licensing requirements. Following tank void filling with Class C grout, capping the TFF units (all 11 tanks), long-term monitoring, and cap maintenance will be transferred to the CERCLA program.

Basis: Transfer of regulatory responsibilities is consistent with the EPA Memorandum titled, "Coordination Between RCRA Corrective Action and Closure and CERCLA Site Activities," Steve Herman and Elliot Laws, September 24, 1996. This identifies the option of crafting CERCLA or RCRA decision documents so that cleanup responsibilities are divided. When units or areas deferred from RCRA to CERCLA, RCRA permits or orders can reference the CERCLA cleanup process and state that complying with the terms of the CERCLA requirements would satisfy the requirements of RCRA. This deferral must be agreeable to the regulatory agencies (State of Idaho and EPA).

6. Option 3 RBCC; CERCLA Fill – The RCRA closure portion of this option will be considered complete after:

   a. Tank system has been isolated

   b. Baseline tank heel and vault contaminant characterization has been conducted

   c. Iterative tank decontamination has been conducted

   d. Iterative vault decontamination has been conducted

   e. Contamination characterization has been conducted

   f. Risk assessment criteria have been achieved based on characterization results

   g. Tank heel has been grouted

   NOTE: Tank heel grouting will be done as a best management practice.

   h. Vault void has been grouted.

   Regulatory responsibility for filling the tank void with CERCLA fill, capping the units (tanks) and long-term monitoring and cap maintenance will be transferred to the CERCLA program.

   Basis: Same as Section 5.2.3, Item 5.

7. Option 4 – Closure to Landfill Standards (CLFS); LLW Fill – RCRA closure portion will be considered complete after:

   a. Tank system has been isolated

   b. Iterative tank decontamination has been conducted

   c. Final tank heel characterization has been conducted

d. Tank heel has been grouted

e. Vault void has been grouted.

Filling the tank voids with an LLW grout meeting NRC Class C limits will be subject to NRC Near-surface Radioactive Waste Landfill licensing requirements. Following tank void filling with Class C grout, capping the TFF units (all 11 tanks), long-term monitoring, and cap maintenance will be transferred to the CERCLA program.

Basis: Same as Section 5.2.3, Item 5.

8. Option 5 – CLFS; CERCLA Fill – The RCRA closure portion of this option will be considered complete after:

a. Tank system has been isolated

b. Iterative tank decontamination has been conducted

c. Final tank heel characterization has been conducted

d. Tank heel has been grouted

e. Vault void has been grouted.

Regulatory responsibility for filling the tank void with CERCLA fill, capping the TFF units (all 11 tanks), long-term monitoring, and cap maintenance will be transferred to the CERCLA program.

Basis: Same as Section 5.2.3, Item 5.

9. Option 6 – CLFS; Clean Fill – The RCRA closure portion of this option will be considered complete after:

a. Tank system has been isolated

b. Iterative tank decontamination has been conducted

c. Final tank heel characterization has been conducted

d. Tank heel has been grouted

e. Vault void has been grouted.

Capping the TFF units (all 11 tanks), long-term monitoring, and cap maintenance will be deferred to the CERCLA program.

Basis: Same as Section 5.2.3, Item 5.

10. Disposal of radioactive waste will be required to meet equivalency of RCRA Subtitle D Landfill standards.

    Basis: Interpretation of IDAPA. The State of Idaho does not currently have authority to regulate Subtitle D landfills, therefore an equivalency determination would be applicable instead of a landfill permit or approval. It is noted that the NRC Class C or DOE LLW landfill requirements meet or exceed the RCRA Subtitle D (industrial landfill) requirements.

11. The TFF is potentially "historically significant" and closure will require compliance with Section 106 of the National Historic Preservation Act.

    Basis: National Historic Preservation Act, Section 106.

5.2.3.1 Environmental and Public Safety

1. Continuous NESHAPs emission monitoring will be required for the RCRA Closure activities and the Class C grout emplacement as the unabated air emissions are assumed to be >0.1 mrem/yr at the INEEL boundary.

   Basis: A comprehensive permit application for the grouting facility would include all aspects of the waste activities. This would provide a complete analysis including temporary storage of the waste, separation, mixing of grout, and placement and/or disposal.

2. Activities associated with the RCRA Closure and emplacement of NRC Class C grout in the tank system will require a CAA PTC.

   Basis: Regulatory interpretation of IDAPA and CAA requirements for similar projects.

3. The Risk Assessment calculation identifying the potential public health risks from residue or contaminants remaining in the tanks after closure will be done by others.

   Basis: This activity is not covered by this scope of work and is being done for the EIS by others.

5.2.3.2 RCRA Closure

1. The sump pumps, or steam jets, will be disposed of as mixed waste.

   Basis: Based on an interview with a TFF expert, the sump pumps are located in the bottom of the tanks and have thus come in contact with process solution. They will be considered mixed waste unless the regulators can be convinced that due to the numerous rinses in the tank they can be considered debris. EDF-TFC-006.

5.2.3.2.1 Closure to RCRA Landfill Standards

1. Tank heel and grout will not be mechanically mixed.

   Basis: The remaining heel will be characterized to verify that the risk of release will not exceed the cumulative ICPP release criteria identified by the CERCLA program. Since this release criteria is already met, mechanical mixing will not be required to hold the remaining waste in a grout matrix in order to meet the ICPP release criteria.

2. Tank heel residue stabilization, as part of RCRA Closure, would not be subject to NRC licensing as a near surface disposal facility per 10 CFR 61.

   Basis: Engineering judgement. No waste will be emplaced that would trigger NRC requirements for incidental waste disposal.

5.2.3.3 NRC Near-Surface Landfill Closure

1. NRC requirements will apply to emplaced LLW.

   Basis: Dec. 19, 1996 Department of Energy Memorandum for the Secretary "Recommendation on Implementing External Regulation" approved December 19, 1996 and DOE press release, December 20, 96.

2. NRC will grant no variances to the incidental waste standards.

   Basis: This assumption is established to provide a cost-bounding scenario.

3. To calculate regulatory requirements and limits for Class C waste emplacement, it is acceptable to use an averaging technique (calculating the radionuclide concentration in the residuals being dispersed in the entire tank volume) to determine the final waste classification.

   Basis: This averaging technique is the same as that used by Savannah River to close tank WC-14. EDF-TFC-045.

4. The grouted heel and Class C grout placed inside a tank will be no greater than Class C when averaged over the entire tank volume.

   Basis: Engineering judgement. The Class C limit for the entire landfill cannot be exceeded.

5.2.3.4 Equipment

5.2.3.4.1 Temporary Vessel Off Gas (VOG) System

1. HEPA filters on the VOG skids will have bag-in and bag-out capabilities.

   Basis: Bag-in and bag-out HEPA filters are currently being used at the ICPP.

5.2.3.5 Enclosures

1. A temporary enclosure will be constructed over the TFF.

   Basis: This will allow work to proceed during adverse weather conditions and provide secondary containment for any potential hazardous material releases. See Section 5.1.1, Item 2 and EDF-TFC-013.

2. The temporary enclosure will be heated and cooled.

   Basis: HVAC will be needed to provide an environment where work can proceed during cold and hot temperature extremes experienced at the INEEL. See Section 5.1.1, Item 2.

3. Enclosure over the TFF will be one large structure.

   Basis: Engineering judgement. A single large structure should be cost bounding and may be required.

4. Secondary containment will only be required for the Total Removal Clean Closure Option.

   Basis: Engineering judgement. The type of work would not require secondary containment.

5.2.4 Clean Closure

5.2.4.1 Total Removal Clean Closure

1. Double containment will be required during excavation activities.

   Basis: Double containment is a conservative assumption for costing and planning purposes for Clean Closure Total Removal based on the requirements defined in DOE Order 6430.1A, "Special Facilities, Irradiated Fissile Material Storage Facilities, and Non-Reactor Nuclear Facilities." DOE 6430.1A has been cancelled, but will remain binding at the INEEL under the LMITCO contract. The LMITCO contract will no longer be in effect when the TFF Closure takes place, but DOE Order 420.1, Section 4.1.1.2, which replaces DOE Order 6430.1A, states: "All nuclear facilities with uncontained radioactive materials (as opposed to material contained within drums, grout, and vitrified materials) shall have means to confine them. Such confinement will act to minimize the spread of radioactive materials and the release of radioactive materials in facility effluents during normal operations and potential accidents. The number and arrangement of confinement barriers and their required characteristics shall be determined on a case-by-case basis and included the Safety Analysis Report for that facility. Engineering evaluations, trade-offs, and experience shall be used to develop practical designs that achieve confinement system objectives." Because of the alpha contamination present in the TFF, engineering judgement leads to the assumption that double containment would still be necessary under this order to minimize the spread of radioactive materials.

2. Both the primary and secondary containment structures will require redundant ventilation systems.

Basis: Double containment requires redundant ventilation systems on both the primary and secondary containment. EDF-TFC-013.

3. Each ventilation system on the primary and secondary containment structures will require a primary and secondary HEPA filter, primary and secondary activated carbon filter, and roughing filter upstream of the HEPA filters.

   Basis: Because of the expected contaminants of concern during RCRA Total Removal Clean Closure, engineering judgement indicates that the listed filters will be required. EDF-TFC-013

4. Primary HEPA filters will be changed before reaching a contamination level of 500 mrem/hr. Each HEPA filter should last a minimum of 3 months.

   Basis: Engineering judgement, based on previous remedial actions performed at the TFF. In most cases, the HEPA filters will be changed due to increased pressure drops across the filter caused by dust loading, not due to the radiation fields. In these cases, the HEPA filters would be disposed of at contamination levels much lower than 500 mrem/hr.

5. The cost per square foot for the double containment will be similar to that used for Pit 9.

   Basis: The ICPP TFF TRCC is similar in scope and contaminants of concern to Pit 9. EDF-TFC-013.

6. The cost estimate for Pit 9 double containment will be modified in order to use weather shields for double containment, not those structures used by Pit 9.

   Basis: The double containment structures used at Pit 9 are too heavy for ground pressure restrictions imposed at the TFF. EDF-TFC-013.

7. A paraffin-based grout will be jet-grouted into the TFF from the bedrock layer to a height of 40 feet (approximately 10 feet below grade) for contamination control purposes. This will bring the grout level with the top of the tanks.

   Basis: Engineering judgement for fugitive dust control and contamination spread concerns.

8. Paraffin-based grout can be jet-grouted before setting up the weather structure and double containment.

   Basis: The paraffin-based grout would be injected without creating a significant amount of dust, thus the spread of contamination due to fugitive airborne dust would not be an issue at this point in the retrieval operation, and double containment would not be necessary.

9. Subsurface cement walls will be jet-grouted into the TFF to provide structural stability for the double-containment structures and the gantry cranes used for excavation activities.

   Basis: Current loading restrictions restrict the use of any heavy equipment or structures in the TFF.

10. Monitoring for VOCs will be done before, during, and after excavating the tanks.

    Basis: Engineering judgement; There is currently no definitive data as to the concentration of VOCs contained in the tanks. The only sampling for VOCs that has been done involved steam jetting the air out of the tanks and then sampling for VOCs, thus diluting and/or destroying the results.

11. Excavations from grade level to approximately 4 feet will be done by operators using standard excavation equipment. Excavations below 4 feet in depth will be done remotely.

    Basis: Historical knowledge indicates that the contaminated areas located in the TFF are due to leaks and/or spills that occurred in the past. These leaks/spills would be from piping systems located on the TFF, thus the spill areas would be below the pipes. The majority of the pipes in the TFF are buried at least 4 feet below grade, thus the excavations above 4 feet can be done manually and the excavation below 4 feet must be done remotely.

12. CERCLA will remove the soils contained in the Environmentally Controlled Areas (ECAs) in the TFF before the tanks, vaults, and pipes being removed under RCRA.

    Basis: Contaminated soils must be removed before removing the tanks, vaults, and piping identified in TRCC operations. EDF-TFC-010.

13. The soil outside of the ECAs moved in order to excavate the TFF tanks, vaults, and pipes will be done as a disturbance (with previous approval) and will remain under the CERCLA umbrella.

    Basis: Soil disturbance is allowed under CERCLA for the soils within the TFF boundary per the Area of Contamination definition. EDF-TFC-009 and EDF-TFC-010.

14. All historical releases to the environment, including but not limited to the soil, groundwater, and bedrock, will be the responsibility of the CERCLA Program. This includes external contamination of structures due to these releases.

    Basis: Historical releases from TFF operations are the responsibility of the CERCLA Program per the FFA/CO.

15. Sampling and characterization needed during removal actions will be performed as an integrated effort between the RCRA and CERCLA programs.

    Basis: Sampling and characterization will be required during excavation under both the RCRA and CERCLA programs and thus will be a shared cost.

16. The boundary for the RCRA work will coincide with the boundary defined by CERCLA in the Waste Area Group (WAG) 3 Cost Estimate.

    Basis: The same boundary must be used for RCRA TRCC work so that the cost estimate done by WAG 3 can be used. Using the same boundary is also necessary due to integration concerns between CERCLA and RCRA. (WAG 3 Cost Estimate and EDF-TFC-010).

17. Tank Heel Removal will begin in 2013, with the tank heels being removed one tank at a time. Once the heel has been removed from an individual tank, the tank will be isolated from the rest of the TFF. TRCC excavation activities will begin once the heels have been removed from all 11 tanks.

    Basis: The soil, tanks, vaults, and ancillary equipment will be completely removed as part of TRCC. The piping located throughout the TFF must be removed in order to access the majority of this equipment. Selectively removing inactive piping would be time consuming and labor intensive. For this reason, it must be assumed that the heels would be removed from all 11 tanks before initiating excavation activities, thus making it possible to inactivate all piping in the TFF.

18. The roof of each tank will be disposed of as mixed waste.

    Basis: The roofs of the tanks have not come in contact with any process solutions (waste), as the tanks have never been filled above the tangent line. However, the tanks have come in contact with acid fumes and airborne contamination, and thus should be assumed to be mixed waste. EDF-TFC-006.

19. The floor panels of the concrete vaults will be disposed of as mixed waste.

    Basis: Any leak that may have occurred in the tanks would have resulted in process solution (waste) coming in contact with the vault, thus making the vault floor a mixed waste.

20. The concrete vault walls will be disposed of as uncontaminated solid waste.

    Basis: The side panels of the concrete vaults have not come in contact with the process solution. EDF-TFC-006.

21. The process piping will be disposed of as mixed waste.

    Basis: The piping has come in contact with the process solution. It is unknown whether rinsing would result in reducing the level of contamination in the pipes and thus allow another disposal method. EDF-TFC-006.

22. The stainless steel liner in the concrete encasements will be disposed of as mixed waste.

    Basis: It should be assumed that the liners will be mixed waste because of known leaks in the piping contained in the trenches. EDF-TFC-006.

23. The concrete encasements will be disposed of as mixed, remote-handled waste (15%) and uncontaminated solid waste (85%).

    Basis: Approximately 15% of the concrete encasements are located in ECA soils and are thus considered mixed waste due to the contamination constituents in the ECA soil. The remaining 85% is located outside of the ECA soil. EDF-TFC-015 and EDF-TFC-016.

24. The pilings will be disposed of as mixed, remote-handled waste (33%) and uncontaminated solid waste (67%).

Basis: Approximately 33% of the pilings are located in ECA soils and are thus considered mixed waste due to the contamination constituents in the ECA soil. The remaining 67% is located in uncontaminated soil. EDF-TFC-015 and EDF-TFC-016.

25. CPP-628, 635, 712, and the valve boxes will be disposed of as radioactive waste.

    Basis: Historical knowledge shows that the buildings and valve boxes are slightly contaminated. They have not come in contact with the process solution, however, and should not be considered mixed waste. EDF-TFC-006.

26. CPP-618, 619, 622, 623, 632, and 634 will be disposed of as uncontaminated solid waste.

    Basis: Interview with a TFF expert. EDF-TFC-006 and EDF-TFC-017.

27. CPP-738 (underground condenser pit) will be disposed of mainly as uncontaminated solid waste; the outer walls as radioactive waste.

    Basis: Interview with a TFF expert. EDF-TFC-006.

28. The tanks will be disposed of as mixed waste.

    Basis: The tanks have come in contact with process solution, and will thus be mixed waste. EDF-TFC-006.

29. Newly generated mixed waste debris, such as equipment, piping, and tank debris will be sent to a Debris Treatment Facility (DTF) (not currently in existence) for treatment to RCRA LDR standards.

    Basis: RCRA regulated debris must be treated to LDRs before disposal. EDF-TFC-015.

30. After the waste debris have been treated, it will be classified as low level radioactive waste (LLW) and will be disposed of at an LLW disposal facility.

    Basis: Once mixed waste has been debris cleaned, the hazardous component has been removed, thus resulting in a waste that can be disposed of as LLW. EDF-TFC-012.

31. Mixed waste, both remote and contact handled, will be shipped to a new DTF in a large volume, large weight payload capable, "moderately" shielded, INEEL-on-site-use-only transport cask, that is operated under locally authored and approved safety documentation.

    Basis: Engineering judgement based on the expected contaminants of concern, as well as the expected concentrations, as presented in the Waste/Inventory. EDF-TFC-015

32. A DTF will be needed for the large volume of mixed waste debris that will result from the TFF TRCC action.

    Basis: A DTF is one of the most efficient ways to properly manage the large volumes of mixed debris wastes per RCRA land disposal restriction standards (LDRs). This is due to the numerous waste codes and the potential inability to use conventional methods of treatment for LDR compliance. A DTF does not currently exist for any significant volume of mixed debris wastes such as would result from the TFF TRCC action. EDF-TFC-012

33. The DTF will be located on the INEEL site.

    Basis: Locating the DTF on the INEEL site allows the use of INEEL-onsite-use-only transport casks, which are much less restrictive that using the DOT approved packaging that would be required to move the waste offsite. EDF-TFC-015.

34. A new LLW disposal site will be built for the large waste volumes generated as a result of the TFF TRCC action.

    Basis: It should be assumed that a new LLW Disposal site would be built for the TFF waste because of the high waste volumes expected from totally removing the TFF. EDF-TFC-015.

35. The LLW disposal site will be located on the INEEL site.

    Basis: Locating the LLW disposal site on the INEEL site allows the use of INEEL-on-site-use-only transport casks, which are less restrictive that using DOT approved packaging. EDF-TFC-015.

36. Treatment will not reduce waste volume.

    Basis: Cost bounding. EDF-TFC-015.

37. Each transport package will contain less than 20 curies of plutonium.

    Basis: The TFF waste type inventory shows low plutonium levels, and the transport of more than 20 curies of plutonium requires doubly contained transport packages (NRC regulation). EDF-TFC-015.

38. Condenser pit (WM-302) will be removed and disposed of as radioactive waste.

    Basis: Engineering judgement. Process knowledge from previous TFF cleanup projects.

39. Remote operations will be required to remove WM-302.

    Basis: Engineering judgement. Based on previous TFF operations in the condenser pit.

40. Geophysical characterization will be done only once and will occur before initiating any excavation activities.

    Basis: Geophysical characterization is typically only done once during retrieval operations to find the main obstacles and obstructions. EDF-TFC-014.

41. Chemical, radiological, and heavy metal characterization will be done separately.

    Basis: The remotely operable digface characterization crane or excavator mounted system currently available through the Technology Development group does not have the capability to do concurrent chemical, radiological, and heavy metal characterization. EDF-TFC-014.

currently available through the Technology Development group does not have the capability to do concurrent chemical, radiological, and heavy metal characterization. EDF-TFC-014.

42. Chemical, radiological, and heavy metal characterization will be done prior to starting excavation; after overburden removal (top 6 inches of soil) and before removing the rubber membrane; after removing the rubber membrane and before removing any pipes; and every 3 feet thereafter. This results in characterization being done a total of 20 times.

    Basis: Because of ALARA concerns during excavation activities, characterization will be an ongoing process. Three-foot intervals will be used due to the sensitivities of the sensors.

43. An independent power source will be provided for all equipment once TFF excavation has started.

    Basis: Electrical junction boxes will be removed at the start of excavation activities. EDF-TFC-006.

44. A digface characterization crane or excavator mounted system will be used for characterization.

    Basis: Field experience using a digface characterization crane mounted system has shown that it would be a good candidate for TFF TRCC activities. EDF-TFC-014.

45. The digface characterization crane or excavator mounted system will be available for use at the TFF.

    Basis: The equipment has been purchased and field-tested by Technology Development.

46. The digface characterization crane or excavator mounted system would be modified to include heavy metal characterization capabilities.

    Basis: The current system does not have heavy metal capabilities, which would be necessary during TFF TRCC activities.

47. All sizing will be done within a double containment structure.

    Basis: Engineering judgement; This is cost bounding.

48. Vault panels will be taken out of the excavation pit whole using a crane and sized within the double containment structure.

    Basis: Engineering judgement; Equipment exists that can perform this activity.

49. Single poured concrete vaults will be sized in place. Aggressive contamination control methods, such as water misting, would be used during sizing activities.

    Basis: Engineering judgement; Contamination control methods will be used that will limit the spread of contamination through airborne fugitive dust.

50. A Contamination Control Unit will be used during excavation activities.

Basis: An aggressive contamination control method will be employed due to the high levels of alpha contamination that may be present during excavation activities. A Contamination Control Unit incorporates varying contamination control methods and has been found to be very effective during field tests at the INEEL. *Evaluation of the Contamination Control Unit During Simulated Transuranic Waste Retrieval*, D. N. Thompson, A. L. Freeman, and V. E. Wixom, EGG-WTD-10973, November 1993.

51. The tanks will be sectioned in place using remote operated equipment before being removed from the TFF.

Basis: Remote operations will be required due to the high levels of contamination expected and the tanks must be sectioned in order to fit in the casks necessary for shipment. EDF-TFC-006.

52. Straps attaching concrete vault panels to the vault pillars will be removed remotely.

Basis: The panels could fall during strap removal. Remotely removing the straps will minimize possible personnel injury.

53. Heel receiver tank will be available when required.

Basis: All cost estimates and schedules are null and void, if the heel receiver tank is not available when required.

54. CERCLA will backfill the excavation pit with the volume of soil estimated in the WAG 3 Cost Estimate (36,569 cubic yards). RCRA will backfill the remaining excavation pit to bring the pit back to grade.

Basis: CERCLA has responsibility for the soils within the TFF Area of contamination. Once the ECA soils are removed, CERCLA would have to backfill the pit to the extent that a cap could be placed over the Tank Farm and monitored. The WAG 3 Total Removal proposed option accounts for this backfill in the amount of 36,569 cubic yards, which is assumed to be "clean" enough to go back in the pit. As the removal of the tanks, vaults, and piping is to be done under RCRA, providing the additional soil needed to fill the void space left by the removal of said components is the under the responsibility of RCRA. EDF-TFC-010.

55. Planning for the INEEL will be comprehensive and integrated.

Basis: In order for any option open for discussion to work, the CERCLA and RCRA programs must coordinate activities so that one option does not preclude alternative options. *INEEL Environmental Management Accelerating Cleanup: Focus on 2006*, Discussion Draft, PLN-177, June 1997.

56. Environmental regulations will not change appreciably over the life of the projects.

Basis: A baseline set of regulations must be used thoughout the planning and cost estimating activities in order for a comparative analysis between options to be feasible, as well as for cost estimating purposes. As no one knows how the regulations will change by the time the work actually takes place, this baseline set of regulations must be assumed to be accurate and constant.

57. Waste storage tanks will be available for decommissioning when required.

    Basis: If the waste storage tanks are not available for decommissioning when required, all cost estimates and schedules are null and void.

5.2.4.2 Risk-Based Clean Closure

1. CLFS methodology can be used for RBCC.

   Basis: RBCC and CLFS methodologies are similar. The only major difference is the level of residue remaining following decontamination efforts. The heel stabilization method can be modified to meet the RBCC criteria.

2. Residual contamination remaining in the tanks will not require delisting before RBCC.

   Basis: As part of the risk assessment and closure process, the contaminants left in a tank will be evaluated to determine whether they pose an unacceptable risk to the public. If the closure performance and risk assessment standards for RBCC are met, RBCC would be achieved. Therefore, the remaining residual contamination and tank system that has come into contact with listed wastes would no longer be managed as a hazardous waste. EDF-TFC-044.

3. Under RBCC, the bins will be decontaminated sufficiently such that Class C requirements will be met if Class C type waste is emplaced in the bin voids.

   Basis: In order to close a tank as an NRC Class C Landfill, the emplaced waste, when mixed with the residue in the tank, must meet Class C requirements.

4. The tank walls will be washed three times with water to clean the tank walls to RBCC requirements.

   Basis: Engineering judgement. A bound was required to provide cost and schedule estimates. The walls will be washed once during the pH adjustments and then two additional times during the tank cleanings conducted to attempt RBCC.

5. Three to four additional water washes (after heel pH adjustment flushes) will be used to clean a tank heel to RBCC requirements.

   Basis: Engineering judgement. A bound was required to provide cost and schedule estimates. The methodology is to trend the cleaning effectiveness with the first three washings. A tank will be washed a fourth time if the first three washings indicate that a fourth flushing would enable the tank to meet the RBCC criteria. The tank would be closed to CLFS if, following the washing, the tanks do not meet the RBCC criteria. Additional washing could be conducted but would change the estimated cost and schedules provided in this report.

5.2.5 RCRA Closure to Landfill Standards

5.2.5.1 Tank Isolation

1. Any piping connections disturbed during closure that are connected to the existing ICPP cathodic protection system will be checked and/or modified to ensure conductivity exists between the disturbed pipe junction(s).

   Basis: The TFF cathodic protection system (currently out of service.) is tied into a cathodic protection system loop at the ICPP. Closure activities will disconnect current piping ties to the cathodic protection system. Action ensures conductivity still exists between any disturbed pipe connection(s).

2. Tank cooling water lines can be grouted from within the supply building without excavation.

   Basis: Engineering judgment after a cursory review of existing piping access.

3. Vessel off-gas (VOG) system piping does not contain hazardous waste.

   Basis: Process knowledge from previous TFF upgrade project.

4. Waste transfer piping between valve boxes and leading into tanks can be decontaminated by flushing with an acidic solution (e.g., 0.5 molar aluminum nitrate), followed by two raw or demineralized water flushes for lines that drain directly into a tank or vault.

   Basis: Decontamination methods used for prior TFF projects. 40 CFR 261.7(b)(1) provides guidance for residues in containers. While not directly related to tanks, it has been used as a performance standard in Closure Plans and should be acceptable for pipe flushing. This guidance coupled with the hazardous debris standard should allow for hazardous waste contaminated pipe washing in this manner. EDF-TFC-034.

5. Waste piping that penetrates the exterior walls of the tank will be decontaminated by pumping grout through the pipes into the tanks, then the pipes will be permanently capped.

   Basis: Engineering judgement. This is consistent with the WCF Closure Plan approved by the State of Idaho for the lines outside the WCF cap.[5-1]

6. Waste piping that lies outside of the footprint of a closure cap will be decontaminated by pumping grout through the pipes into the tanks or vessels, then the pipes will be permanently capped.

   Basis: Engineering judgement. This is consistent with the WCF Closure Plan approved by the State of Idaho for the lines outside the WCF cap.[5-1]

7. Utility and instrumentation lines will be cut, capped, and left in place regardless of slope.

   Basis: TFF process knowledge instrumentation lines have not had process waste in them and are contamination free.

8. The worst case for general body field radiation for a valve box will be 500 mrem/hr.

   Basis: The general body fields are from radiation surveys done during work on the TFF.

9. The grout pump and associated equipment used for vault and tank grouting will be used for grouting the waste transfer piping and any other lines that require grouting.

   Basis: The proposed grout pump has a variable output that can be adjusted to accommodate low flow rates. This pump could be adjusted to match the flow rate required to fill each line.

10. The cooling water contained in the tank cooling coils and surge tanks can be sent to the PEWE.

    Basis: The cooling water components will not pose a problem to evaporate or calcine. EDF-TFC-027.

5.2.5.2 Heel Stabilization

1. Mechanical mixing or stirring of the grout and heel will not be required to immobilize the heel in a nonleachable, homogeneous matrix.

   Basis: Installation of a permanent cover over the TFF will prevent the entrance of liquids that could potentially leach out radioactive and hazardous heel constituents that have not been immobilized.

2. Heel stabilization will begin within 2 years after that tank reaches a "cease use" condition.

   Basis: Heel stabilization is expected to take the longest amount of time with respect to all the tasks. Stabilization must start shortly after "cease use" to facilitate closure of all TFF tanks. The 2-year period would allow for preparatory work such as equipment removal and temporary VOG system installation.

3. A criticality will not occur.

   Basis: Preliminary calculations based on assumed heel content indicate a safe condition. Sampling and analysis will be required to verify this before implementation.

4. Existing tanks or vessels will be available to accept heels from tanks that are being closed.

   Basis: Tank liquids that have been removed during closure activities must either be contained in a holding vessel for future processing or be processed as the liquids are removed. Existing tankage could be used.

5.2.5.3 Vault & Tank Void Management

1. Clean grout will be transported to the TFF site by ready mix delivery truck.

   Basis: The cement delivery truck was found to be the best means of providing grout to the ICPP as indicated by the "Comprehensive Work Scope for the Waste Calcining Facility

RCRA Closure Project Division IV" and the "Grout Mixing and Handling Option Special Study for the WCF RCRA Closure Project."

2. Grout lift curing will take no longer than 7 days to cure before another grout layer can be poured.

   Basis: Engineering judgement. Similar to other void filling applications using grout such as the WCF closure. This is the expected time required to dissipate heat generated by the grout hydration process. EDF-TFC-033.

3. A grout equipment cleaning and decontamination area (both Class C and clean) shall be available before tank and vault void grouting.

   Basis: Grouting operations will coat equipment with grout residue. This residue requires removal to allow continued equipment use. Contaminated equipment also requires additional care to minimize the spread of contamination to the environment.

4. An equipment cleansing facility shall be designed and located to provide the most efficient area location in terms of cleaning time, distance to the grout equipment, and accessibility.

   Basis: Engineering judgement. Locating the facility close to the closure operations will allow process optimization and a reduction in TFF Closure costs.

5. Self-leveling grout will be defined as grout that slumps down to within 1-inch of the lowest grout height within a 50-foot diameter.

   Basis: Engineering judgement. This provides a basic characteristic for the grout used to fill each TFF tank and vault void.

6. An aboveground concrete structural cap will not be installed over the TFF or separate tanks.

   Basis: The grouted vault void will act as a cap encasing the tank. This internal cap will minimize water infiltration, give structural support and function with minimum maintenance. Grouting of the vault void provides a temporary cover or cap until CERCLA places the final cap or cover over the entire TFF after closure completion.

7. Although tank and vault access is possible, personnel will not be allowed entry into the tanks or vaults.

   Basis: To protect personnel from radiation exposure.

8. Pipe running to the tank and vault void spaces will be made of stainless steel.

   Basis: For cost bounding purposes, other piping could be used but may not hold up to multiple uses in an abrasive environment.

9. Piping will remain in place until the tank and vault voids are completely filled.

   Basis: To minimize pipe disassembly after each grout run. This also minimizes exposure to LLW grout if such grout is used and the need for storage facilities.

10. Flexible pipes will be used to manually connect the clean grout supply pipe to pipelines leading to the tank or vault void.

    Basis: Flexible pipes will minimize the design time and initial manufacturing expense compared to a manifold design. The lack of radioactive constituents should eliminate the need for a manifold.

11. Remote visual monitoring will occur during void filling and decontamination activities.

    Basis: Monitoring will provide a visual verification that required steps have been completed, grout lift height verification, and ensure even grout distribution withing the tank and/or vault.

12. The 7 day grout curing duration will allow enough time for the grout to reach a compressive strength high enough to accommodate the next lift.

    Postheating of grout will not be required.

    Basis: Engineering judgement. Grout composition is expected to provide minimal water bleeding. Additional moisture removal should not be required.

5.2.5.3.1 Vault Void Management

1. Four equally spaced pipelines will evenly fill the vault void with grout.

   Basis: Engineering judgement; Four equally spaced pipes should provide sufficient grout distribution to fill the vault void annulas.

2. Void filling grout shall be designed to minimize water permeability.

   Basis: Low water permeability will minimize the amount of moisture that reaches the outer tank walls and therefore, minimize corrosion of the tank due to liquids.

3. Vault filling will not occur until all tank heels in a selected group are stabilized and ready for filling at the same time.

   Basis: Waiting to fill a group of tanks at one time will reduce the startup and shutdown costs that would be associated with filling each vault separately.

4. All vault voids will be filled beginning with an 18-inch lift.

   Basis: The 18-inch lift ensures that the tank will not float during vault filling operations. EDF-TFC-024.

5. A flexible pipe section will be used to manually connect the grout supply pipeline to the four vault filling pipelines.

   Basis: A flexible pipe will minimize the design time and initial manufacturing expense compared to a manifold design. The lack of radioactive constituents would not require a manifold.

6. Vault voids will not maintain air pressure.

   Basis: Vaults were not designed to be airtight. Air could migrate through the pillar and panel joints, through piping encasement (raceways) connections or through the vault roof and vault wall joints.

7. Access to the vault voids will be acquired through existing and newly installed vault risers.

   Basis: Riser positions will be selected to provide ideal grout placement. Other existing access ways such as manways and pipe raceways will not provide adequate access into the vault void.

8. A 4-foot grout lift will be the maximum placed in the vault void at one time while the tank void is empty. The lift sequence and maximum height will correspond to values provided in EDF-TFC-022 with the exception of the 4-foot lift limitation.

   Basis: To provide a minimum safety factor of 8 during filling. This safety factor will minimize filling problems that may arise during vault void filling. (EDF-TFC-022)

5.2.5.3.2 Tank Void Management

1. Sufficient NRC Class C grout will be available to fill a 300,000-gallon tank with a 2-foot lift (approximately 145 yd^3) at one time.

   Basis: The grout fill is the maximum estimated lift that can be placed in a tank at one time. Filling a tank to this maximum lift height will minimize the time required to completely fill each tank.

2. Class C grout will be delivered via pipeline to the north TFF boundary immediately north of Tank WM-185.

   Basis: Pipeline placement provides the optimal location for supplying grout to all 300,000-gallon tanks.

3. Tanks will structurally support the pressure created by grout lifts placed inside or outside the tank.

   Basis: Preliminary analysis indicates that tanks can support pressure when combined with limited and controlled grout lifts. EDF-TFC-022.

5.2.5.4 Option Development

A discussion on option development can be found in Sections 7 and 8. The assumptions made within the discussion are listed below:

5.2.5.4.1 General Risk-Based Clean Closure (Options 2 and 3) and Close to RCRA Landfill Standards (Options 4 and 5)

1. The second group of six vault voids (WM-180, WM-181, and WM-187 through WM-190) will be filled in sequence.

   Basis: The second vault void group will be ready for closure after the first group. Filling the vaults in sequence allows for a dedicated work group to complete the vault-filling task with minimal break time and workforce restructuring in between fills.

2. Each vault grout lift filled in sequence will <u>not</u> require more than a 7-day curing time to dissipate heat generation created by the grout hydration process.

   Basis: Keeping the curing time to 7 days or less will allow the next vault void grout lift to commence shortly after filling the last tank in the sequence. This will minimize the vault void filling time and expense. Heat generation is not expected to affect filling the vault void. EDF-TFC-033.

5.2.5.4.2 Close to RCRA Landfill Standards: Clean Fill (Option 6)

1. Curing of vault and tank grout lifts will take no longer than 7 days before another grout layer can be poured.

   Basis: It will take approximately 7 days to allow heat dissipation between pours. EDF-TFC-033.

2. Vault and tank void space filling of the first five tanks will start by 2013.

   Basis: Engineering judgment. Actual time required to prepare the tanks systems for vault and tank void filling is expected to take the majority of the closure time.

3. The second group of six vault and tank voids (WM-180, WM-181, and WM-187 through WM-190) will be filled in 2-foot lifts and one tank after another until all six are completely filled.

   Basis: The second vault and tank void group will be ready for closure after the first group. Filling the vaults in sequence allows for a dedicated work group to complete the vault and tank filling task with minimal break time and workforce restructuring required in-between fills. The 2-foot lifts will be the maximum grout thickness that can be poured and not affect grout integrity.

4. Vault and tank void space filling of the second six tanks will start by 2020.

   Basis: Engineering judgment. Actual time required to prepare the tanks systems for vault & tank void filling is expected to take the majority of the closure time.

5. Vault and tank void space filling of all 11 tanks will be completed by 2035.

   Basis: Engineering judgement. The work is estimated for completion by this date.

6. Vault and tank void space filling of the first five tanks will start by 2013.

   Basis: Engineering judgment. Actual time required to prepare the tanks systems for vault and tank void filling is expected to take the majority of the closure time.

7. A flex tube system similar to the one used for vault void filling will be used to tie separate grout sources to the tank and vault being filled.

   Basis: A flex tube arrangement will minimize the design time and initial manufacturing expense compared to a manifold design. The lack of radioactive constituents would not require a manifold.

5.2.5.4.3 Close to RCRA Landfill Standards; LLW Fill (Option 4)

NOTE: This option uses the empty void space created by Option 1 and does not begin until all TFF tanks have been RCRA closed.

1. Tanks will be RCRA closed before filling tank voids with Class C grout.

   Basis: Closing the tanks per RCRA before filling will minimize the number of regulatory agencies controlling the work.

2. Curing of grout lifts will take no longer than 7 days before another grout layer can be poured.

   Basis: It will take approximately 7 days to allow heat dissipation between pours. EDF-TFC-033.

3. A remote operated manifold will be used to connect the main supply line to each tank feed line.

   Basis: Using a manifold to connect each tank to the NRC Class C grout line will minimize radiation exposure to personnel and minimize chances for a noncontained system leak. This minimization occurs by limiting the number of times the system piping must be connected and disconnected.

4. The remote operated manifold will be a self-contained unit.

   Basis: Providing a self-contained manifold will minimize personnel exposure to radioactive fields and minimize potential radioactive released and contamination. A self-contained manifold could also allow for disposal as its own shipping container.

5. The manifold will be replaced after each 11-day filling run.

   Basis: Replacing the manifold after each run will allow using the manifold as its own containment system and eliminate a possibly difficult decontamination effort. This containment system would provide secondary containment for any leaks that may occur inside the manifold system. This replacement would minimize potential worker exposure by removing the radioactive material contained in the manifold. Replacement would also provide a verified operational component, as this system must operate as designed.

6. A weight load distribution system for spreading the shielded piping weight will be used in the TFF.

   Basis: Engineering judgement. Any shielded pipe is expected to exceed the 1,000-lb nonvehicle weight load limit within the TFF. A load distribution system would spread out the load allowing shielded pipe use.

7. Piping from the NRC Class C grout batch plant to the manifold will remain in place until tank voids are completely filled.

   Basis: Leaving the piping in place will minimize costs associated with decontamination, removal, storage, and reinstallation.

8. Piping from the manifold to each tank will remain in place until voids are completely filled.

   Basis: Leaving the piping in place will minimize costs associated with decontamination, removal, and reinstallation.

9. Class C grout lines will be cleaned with a pig and then flushed with a pig, water, pig cartridge and left in place until the next grout run.

   Basis: Cleaning in this manner will minimize the amount of grout residue left in the piping and allow piping reuse. Reducing the residue amount will reduce the radiation field.

10. The water amount in the pig-water-pig cleaning cartridge will not exceed 2 gallons.

    Basis: Engineering judgement. This liquid amount will fill approximately 10 ft of pipeline, which should provide sufficient pipe wall washing capability.

11. Piping from the grout batch plant to each tank will remain in place until voids are completely filled.

    Basis: Leaving the piping in place will minimize costs associated with decontamination, removal, and reinstallation.

12. Class C piping will be 2 inches in diameter stainless steel, double containment, with concrete shielding.

Basis: Engineering judgement. The 2-inch line should provide sufficient flows for void filling. Double containment for a 2-inch line would make the over all outside pipe diameter approximately 4 inches. Increasing the pipe diameter increases the double wall containment pipe diameter. The shielding required would then increase, which would increase the overall pipe weight. This increase in weight would require additional weight distribution measures.

13. Existing pipe control-center trailer will be used for Class C grouting operations.

    Basis: Using existing equipment will reduce the overall project cost.

14. All equipment that cannot be decontaminated will be disposed of in an approved landfill.

    Basis: Contaminated equipment must be cleaned, stored, or disposed of. Using a permanent disposal site will reduce overall long-term costs and chances of personnel exposure for items that are difficult and costly to decontaminate.

15. Postclosure monitoring will occur after landfill activities have been completed.

    Basis: Monitoring will provide indications of waste leaching, containment breaches, waste migration, and is required by current regulations.

16. All tanks will be filled by 2035.

    Basis: Engineering judgement. Proposed filling completion date.

17. Only radiation from Cs-137 / Ba-137 m will be considered for the purposes of estimating radiation exposure from Class C grout.

    Basis: This nuclide combination accounts for over 99% of the penetrating radiation from those listed in Table 32 of EDF-FDO-001, "Estimates & Waste Volumes, Compositions & Properties."

18. Curie content of Cs-137 will be 590 Ci/m^3, and Ba-137 m will be 560 Ci/m^3.

    Basis: Source term calculations listed by Charles Barns, "Estimates & Waste Volumes, Compositions & Properties," Aug. 21, 1997, EDF-FDO-001, FFN-ED-01, ED-01. File #73301-Final Disposal Options.

5.2.6 Radiological Protection and Controls

1. Radiological work anticipated to exceed individual or collective dose criteria established in the IRCM, 100 mrem and 500 mrem respectively, will be reviewed and approved by the ALARA Committee.

   Basis: IRCM, Art. 312.6.

2. The weather structure will be continuously monitored for radionuclides, VOCs, and heavy metals.

Basis: An environmental conditions monitoring system will be needed to ascertain potential releases during retrieval operations. EDF-TFC-013.

3. Individual "Large Area Containments" will be used inside of the weather enclosure for radiological control.

   Basis: Company Policy per MCP-198.

4. Large Area Containment enclosures will have an air flow model developed for the ventilation system.

   Basis: Engineering judgement. Airflow models will predict, in the event of a contamination release, the most probable travel path for the released material to follow. This will provide evacuation and contamination detection criteria to be established.

5.3 References

5-1 Lockheed Martin Idaho Technologies Company, *HWMA Closure Plan for the Waste Calcining Facility at the Idaho National Engineering and Environmental Laboratory*, INEEL-96/0189, Rev. 2, June 1997, page 31, Table 4, and page 32, Table 5.

6. SITE PREPARATION

Initial site preparation work must take place before performing TFF Closure activities. Site preparation work includes the following activities:

- Establishment of access corridors within the TFF to ensure safe transit and placement of equipment and personnel
- Installation of temporary utilities such as electrical power, water, air, and steam
- Erection of temporary enclosure(s) over the tank or tanks being closed
- Installation of structures such as construction trailers, control trailers, and storage bunkers for interim storage of contaminated equipment.

Site preparation activities are discussed below.

6.1 Tank Farm Facility Access

Because of the limited load-bearing capacity of the tanks and vaults, access routes for vehicles and equipment must be carefully planned and supervised to ensure that these structures are not damaged during TFF Closure activities. Corridors for equipment movement and placement must be planned, laid out, and marked on a tank-by-tank basis. Section 6.2 discusses TFF load limitations in further detail.

If necessary, new gates will be installed in the perimeter fence to improve vehicle and equipment access into the TFF. Proposed plans for equipment movement and placement within the TFF will be reviewed by cognizant operations, safety, and engineering personnel before mobilization of vehicles or equipment on or near the tanks and vaults.

Placement of cranes to remove or install equipment must be closely evaluated to ensure that the combined weight of the crane and load do not exceed the loading limit for the designated area. Heavier items such as concrete trucks and associated equipment will be located outside of the TFF's north perimeter fence.

Personnel entering or leaving the TFF Area will be trained and supervised to ensure compliance with radiological controls. Radiological controls must be established at entrances and exits to ensure that personnel and equipment do not enter or exit the area with radiological contamination. Surveys of personnel and equipment using portal monitors and/or hand-held instruments will be taken before leaving the TFF Area. Refer to Section 10 for further information on radiological controls.

6.2 Tank Farm Load Limitations

This section addresses maximum load limits that have been established for vehicles, equipment, and personnel in the TFF. Maximum load limits were established to protect the vaults from structural damage that might result from unrestricted operational loading, because of the limited load-bearing capacities of the vaults.

TFF load restrictions will be an important factor when determining the equipment used for closure activities. Load limits and functional requirements must be used as the basis for determining equipment used in closure activities. Equipment purchased based on functional requirements alone may be unacceptable for use inside the TFF. Load size and equipment placement over the vaults must be evaluated to determine the overall impact to the structural integrity of the TFF.

6.2.1 Load Zones and Limits

An engineering study[6-1] was performed to evaluate the effects of various vehicle loads on the TFF vaults. The study was initiated to address concerns that large cranes, multiple trucks, or other equipment placed within the TFF could result in damage to or collapse of the vaults. A vault collapse could damage the waste storage tank contained inside. Based on this study, load limits were established for vehicular and nonvehicular loads within the TFF to ensure the TFF vaults were not overstressed.

The TFF is divided into four discrete areas or zones (A, B, C, and D) for the purpose of establishing load limits. Zones A, B, C, and D are further divided in subzones such as A-1, A-2, B-1, B-2, etc. In general, Zones A and B are located over the tanks and tank vaults, Zone C includes the region between the tank vaults, and Zone D lies on the TFF perimeter. The A and B subzones have the most restrictive load limits.

See Figure 6-1 for a TFF layout and the load limit zones.

Specific information regarding TFF load limits may be found in Management Control Procedure CPP-MCP-P7.5-A1, "Tank Farm Surface Load Limitations," and Technical Specification TS4.2B14, "Load Controls for ICPP High-Level Liquid Waste Tank Vaults." A copy of these documents can be found in Reference 6-2.

6.2.2 Load Requirements and Restrictions

The requirements and restrictions for loads in the TFF are listed below.[6-2,6-3]

1. A maximum of two Category I vehicles/equipment (i.e. Ford F150, F250, etc.—except Bobcat 735), with at least 10 feet clear between supports are allowed in each Zone A at any given time.

2. A maximum of two Category I vehicles/equipment (i.e. Ford F150, F250, etc.), at least 10 feet clear between supports, are allowed in each Zone B at any given time.

3. Each zone C can accommodate only one of the following vehicle/equipment combinations at any given time:

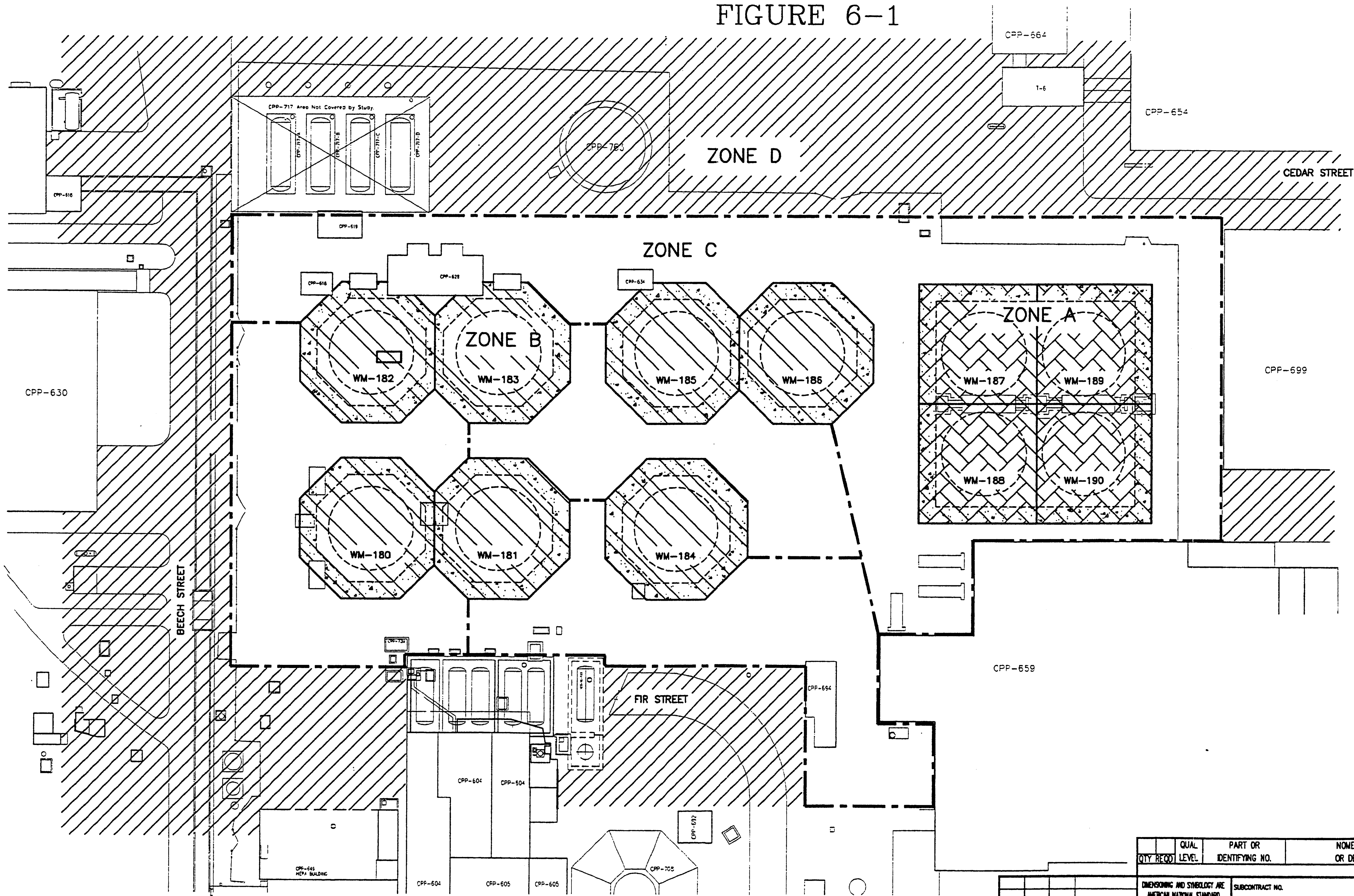
    a. Four Category I vehicles/equipment (i.e., Ford F150, F250, Personnel, etc.)

    b. Two Category I vehicles/equipment (i.e., Ford F250, Personnel, etc.) and one Category II Vehicle (i.e. Backhoe, Small Cranes, etc.)

    c. Two Category II vehicles/equipment (i.e., Backhoe, Small Cranes, etc.)

    d. One Category III vehicles/equipment (i.e., Dump truck, Medium Cranes, etc.)

LOADING ZONES
FIGURE 6-1



REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE:

QTY REQD	QUAL LEVEL	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.

PARTS LIST

DIMENSIONING AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD UNLESS OTHERWISE SPECIFIED SURFACE ROUGHNESS 125/ DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03 .XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING

DASH NO. | NEXT ASSY | FINAL | QTY REQD | NEXT ASSY | APPLICATION

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: GREG HOUSLEY
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
TANK FARM LOADING ZONES

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER AREA TYPE G ORG 530 | DWG– | REV
SCALE: NONE | SHEET 1 OF 1

User: gth Date: 09/17/97 – 08:08 A.M.
File: loadzone.dwg Path: ~gth/Rick

Any other combinations of vehicles with a sum of weighting factors of 4.0 or less, is also allowed in each zone C. Weighting factors for each vehicle load category are given in CPP-MCP-P7.5-A1.

4. Each zone D can accommodate any combination of Category I, II, III or IV vehicles/equipment (Category IV vehicles/equipment: Heavy Cranes, Heavy loaders, etc.)

5. Vehicles shall travel under 2.5 mph in TFF zones to prevent amplifying wheel pressure upon the soil.

6. Vehicle loading requirements are for dry soil conditions. Vehicles shall not be allowed in these zones during saturated soil conditions.

7. Maximum lift loads for all cranes shall be 12,000 lb.

8. Vehicles are assumed to be carrying their rated capacity or 12,000 lb, whichever is less.

9. Lift loads on cranes shall be kept low when moved over the TFF.

10. Nonvehicle loads shall be less than 1,000 lb per zone.

CPP-MCP-P7.5-A1, "Tank Farm Surface Load Limitations," lists the vehicles, category types, and weighting factors that are approved for use in the TFF. Nonapproved vehicles require an analysis to be performed by cognizant facility personnel. This analysis will determine the equivalent category type. Criteria used to determine category type are: combined weight and lift load, number of vehicle axles and supports, distance between vehicle axles and supports, and contact area of the vehicle supports. Other studies may justify allowing larger vehicle numbers in a zone, with specific limitations on location and loading of those vehicles.

6.2.3 Examples of TFF Loading

Vehicles, equipment, structures, and personnel placed in different zones throughout the TFF contribute to loading on the vaults during closure activities. Each load must be evaluated to ensure that the total loading in a subzone will not exceed the maximum load limit for that subzone.

Examples of vehicles, equipment, and structures that will impact loading in the zoned areas include:

1. Tank Closure Equipment - washdown arm, grout delivery arm, mixing pump, transfer pump, video equipment, and tank lighting

2. Vault Closure Equipment - washdown arm, video equipment, tank lighting, and monitoring system

3. Trucks - utility, flat-bed, dump

4. Cranes, backhoes, front-end loaders, excavator, drilling rig

5. Temporary VOG System - blower, filter skid, ducting

6. Grout System - cement truck, grout pump, piping, weight distribution system

7. Radiological - shielding, containment tents

8. Buildings - temporary enclosure, construction trailers.

Table 1 in EDF-TFC-038 contains examples of equipment that may be used in closure activities along with the corresponding weights.

6.3 Utilities

The following plant utilities will be required to support TFF Closure activities:

1. Electrical power

2. Raw and potable water

3. Plant steam

4. Compressed air.

6.3.1 Electrical Power

Electrical power will be required for the temporary enclosure, temporary VOG system, tank washdown equipment, grouting equipment, mixing pumps, submersible pumps, and auxiliary equipment such as lighting and power tools.

A previous project already established 3-phase, 480-volt electrical power at several locations in the TFF (see Figure 6-2). The 3-phase, 480-volt electrical power is supplied by a transformer (XFR-NCE-392) located to the northeast of CPP-654. The 480-volt power sources in the TFF are fed by disconnect switch DSW-NCE-01.

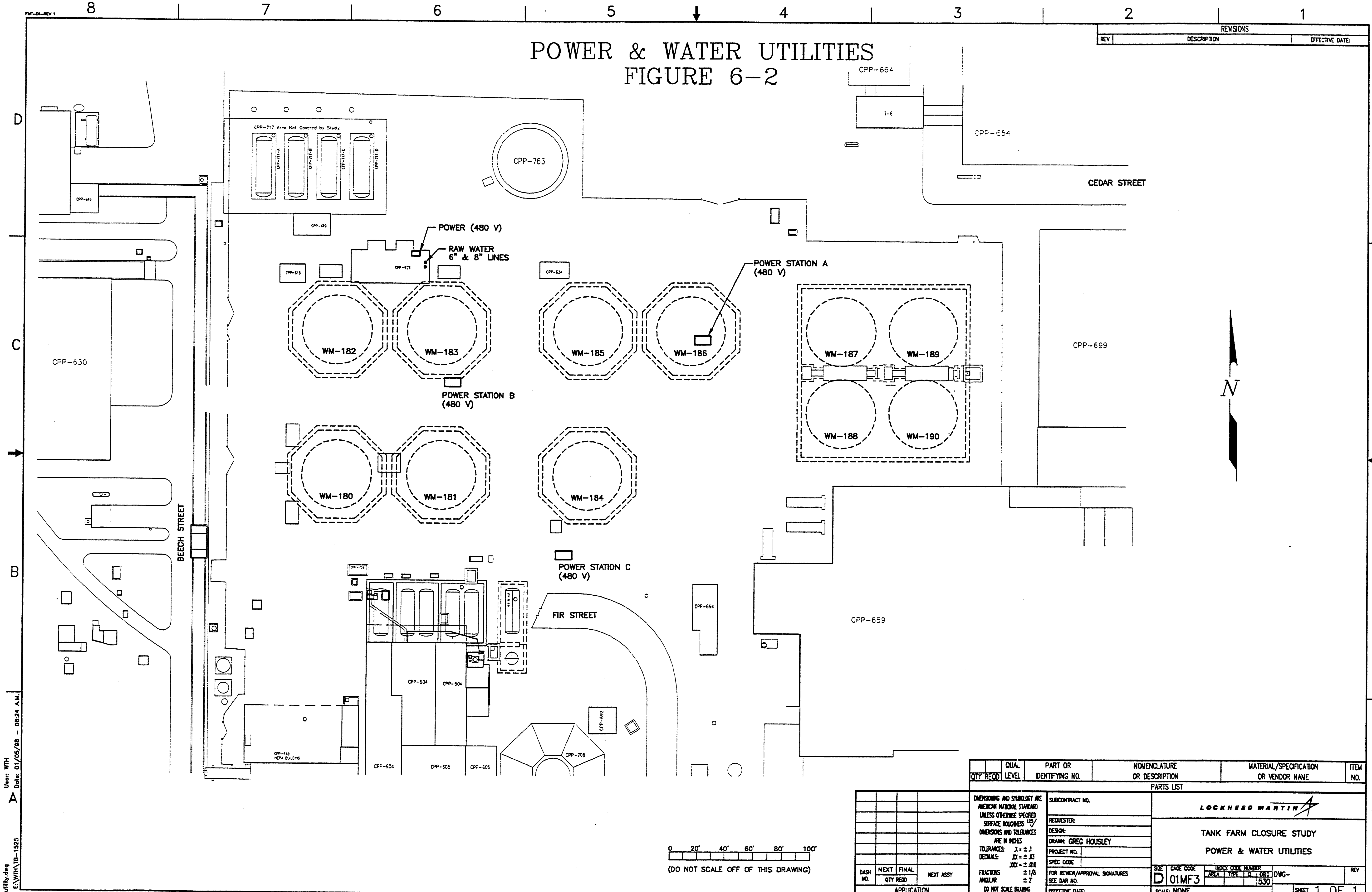
It is anticipated that major equipment such as the mixing pumps and blowers will require a 3-phase, 480-volt power source. Most auxiliary equipment such as video cameras, tank lighting, and power tools will require a 120/208-volt power source or less. Portable skids equipped with step-down transformers may be used to supply power for auxiliary equipment. These step-down transformers would tie into the 480-volt power source available for tank closure activities.

Further analysis of power requirements for equipment will be necessary during the design of TFF Closure equipment. Power supply points, protective devices, conductor sizes, and electrical distribution can then be determined based on equipment load requirements.

6.3.2 Water

Water may be required for initial decontamination of existing equipment in the tank risers. Raw water will also be used to clean equipment used in the grouting process such as the grout delivery arm, piping, concrete pump, and associated apparatus. Potable water will be used for human consumption and personal hygiene.

POWER & WATER UTILITIES
FIGURE 6-2



An outlet at CPP-628 (see Figure 6-2) would provide one possible source of raw water for the TFF Area. A local raw water distribution system with taps could be constructed for use during the entire tank closure process. Fire hydrants could also provide a convenient outlet during the frost-free periods of late spring, summer, and early fall. Use of fire hydrants will require coordination and approval from fire protection personnel to ensure that fire protection for the TFF is not compromised.

Winter water use will require freeze protection such as heat trace and insulation for abovegrade pipe runs. This may require using a water source other than fire hydrants during the winter months since the hydrants could be exposed to freezing temperatures if the hydrant is not inside the heated temporary enclosure.

Further study is required to determine the best water supply tie-in location along with routing of temporary piping for the different tanks. Freeze protection methods must also be investigated to determine the best method to prevent freezing problems. Application and placement of pressure-reducing regulators and control valves must also be considered when laying out a temporary water system.

6.3.3 Steam

Steam lines are already in place for the steam jets used to transfer liquid wastes out of the tanks. If steam is required for other uses such as heat tracing or cleanup, additional study will be required to determine additional steam production requirements, delivery pressures, tie-in points, and steam line routing. Steam line freeze protection must also be considered when designing and laying out any temporary steam supply system.

6.3.4 Air

Compressed air may be used when cleaning out various pipeline such as grout supply lines. Compressed air will also be used to "blow out" transfer lines, cooling coils, and other piping.

Although plant air is available in different areas of ICPP, it may be more cost-effective to use a portable air compressor. Manufacturers such as Ingersoll-Rand or SullAir build a variety of air compressors that should meet both pressure and volume demands. Portable air compressors would provide flexibility in regard to movement and placement of an air source in the TFF. A possible drawback to using a portable air compressor would be the effect of adding diesel/gasoline engine exhaust emissions to the atmosphere. Further study will be required to determine the best method of supplying air to the TFF.

6.4 Tank Farm Enclosure

An enclosure that encompasses either the entire TFF or selected TFF regions would provide protection for personnel and equipment during adverse weather. An enclosure that is heated during the winter and cooled during the summer would permit TFF Closure activities to be performed year round. During cold weather, the enclosure could be heated to maintain the inside temperature above +40°F when the outside temperature is -10°F. During warm weather, the enclosure could be cooled to maintain an inside temperature below 80°F when the outside temperature is 38°C (100°F).

A structure that encompasses the entire TFF will be the method considered for providing protection to personnel and equipment for Option 1. The main portion of the enclosure would be approximately 260 feet by 360 feet. An extension on the east side of the enclosure would be approximately 180 feet by 200 feet. Clearance between the ceiling and ground would be 55–60 feet to allow equipment installation and removal with cranes.

To minimize operating costs, the enclosure could be sectioned into heating, cooling, and lighting zones that would allow individual control. By limiting the work area to a specific section of the enclosure, operational costs would be less than if the entire building were to be heated or cooled.

Options 2 through 6 use a lightweight, movable structure such as a Sprung Structure[6-3] that encloses two tanks. When work is finished on the tanks surrounded by the enclosure, the enclosure would be moved to the next tanks in the closure sequence. Since overhead clearances in the enclosure may be limited, installation and removal of large equipment in the tanks might require locating a crane outside the enclosure. Portions of the enclosure roof would be removed or opened to allow crane access.

Selection of an enclosure for the TFF is beyond the scope of this study and will require further study. Factors that should be considered when selecting the style and size of an enclosure include: impacts to the TFF due to increased loading caused by the structure; crane access for installation and removal of equipment within the tanks and vaults; requirements for fire protection, heating, ventilation, and lighting; tank closure sequence; and closure option.

6.5 Support Buildings

Structures that support TFF Closure activities such as trailers or storage bunkers may be installed in the open area north of the TFF. The structures must be placed such that the vaults are not structurally affected. The structures must also be placed so they do not interfere with closure activities.

Structures that will be installed as part of site preparation work include:

1. Construction trailers for personnel, equipment, and material

2. Trailers with controls, instrumentation, and alarms for the temporary VOG system, mixing pump(s), waste transfer pump(s), etc.

3. Bunker(s) for interim storage of radioactively contaminated equipment.

Further study will be required to determine the actual size and location for the structures listed above.

6.6 References

6-1 Advanced Engineering Consultants, Inc., *Evaluation of Existing Vaults for Vehicle Loads, HLWTR Project,* August 1993.

6-2. K. D. McAllister, "Tank Farm Load Limitations," EDF-TFC-038.

6.3. R. A. Gavalya,, *Sprung Structure Vender Data*, EDF-TFC-036.

7. CLEAN CLOSURE

If all hazardous waste, contaminants, waste residue, including contaminated soils, and equipment, can be removed from the site or units at closure, the site or unit can be "clean closed" (see Section 4.3.5.2). "Clean Closure" requires:

1. Removal of all waste residue

2. Decontamination of equipment and structures to be left in place; and the proper management of equipment and wastes that are removed.

This may be demonstrated by two methods:

1. First method is achieved by the complete removal of the tank system and contaminants. For the purposes of this study, this method is referred to as Total Removal Clean Closure or TRCC.

2. Second method is a risk-based method, which requires that an owner/operator demonstrate that levels of hazardous contaminants remaining after decontamination do not exceed the risk-based performance standard. For the purposes of this study, this method is referred to as Risk-Based Clean Closure or RBCC.

For both methods, a site-specific decontamination plan is developed to establish the most appropriate cleanup method or combination/sequence of methods that would achieve the closure performance standard. Factors considered in the decontamination plan include:

1. Worker and environmental health and safety requirements

2. Volume and type of wastes generated (waste minimization)

3. Cost and schedule

4. Future use of equipment and facilities.

Following waste removal and achievement of the closure performance standard, postclosure care or filing of a plat would not be required, as the system is no longer regulated under RCRA. The requirements for RCRA clean closure standards are found in Section 5.

The following subsections describe how the TFF can be closed to RCRA Clean Closure standards:

Section 7.1 discusses Total Removal Clean Closure. The total removal tasks include:

1. Removing tank heels as much as practical

2. Removing the remaining residual heel

3. Drying the tanks

4. Removing (Decontaminating and Decommissioning) all tanks, vaults, ancillary piping, CERCLA soils, and auxiliary equipment associated with the TFF

5. Packaging all waste items and shipping to various locations, depending on waste type

6. Filling the excavation pit to grade level.

Section 7.2 discusses Risk-Based Clean Closure. The risk-based tasks include:

1. Developing risk assessment criteria for the TFF

2. Characterizing the heel

3. Performing the tank heel waste removal process

4. Verifying compliance with risk assessment criteria

5. Characterizing vault contamination

6. Performing vault decontamination

7. Verifying compliance with risk assessment criteria

8. Closing tanks per risk assessment criteria

9. Minimizing free liquids in tank and vault.

7.1 Total Removal Clean Closure

Total Removal Clean Closure (TRCC) involves the complete removal of the TFF tanks, vaults, piping, auxiliary equipment, and contaminated soil. Theoretically, only sagebrush and clean dirt will be left in the TFF Area at the completion of TRCC. The boundaries for Total Removal are shown in Figure 7-1.

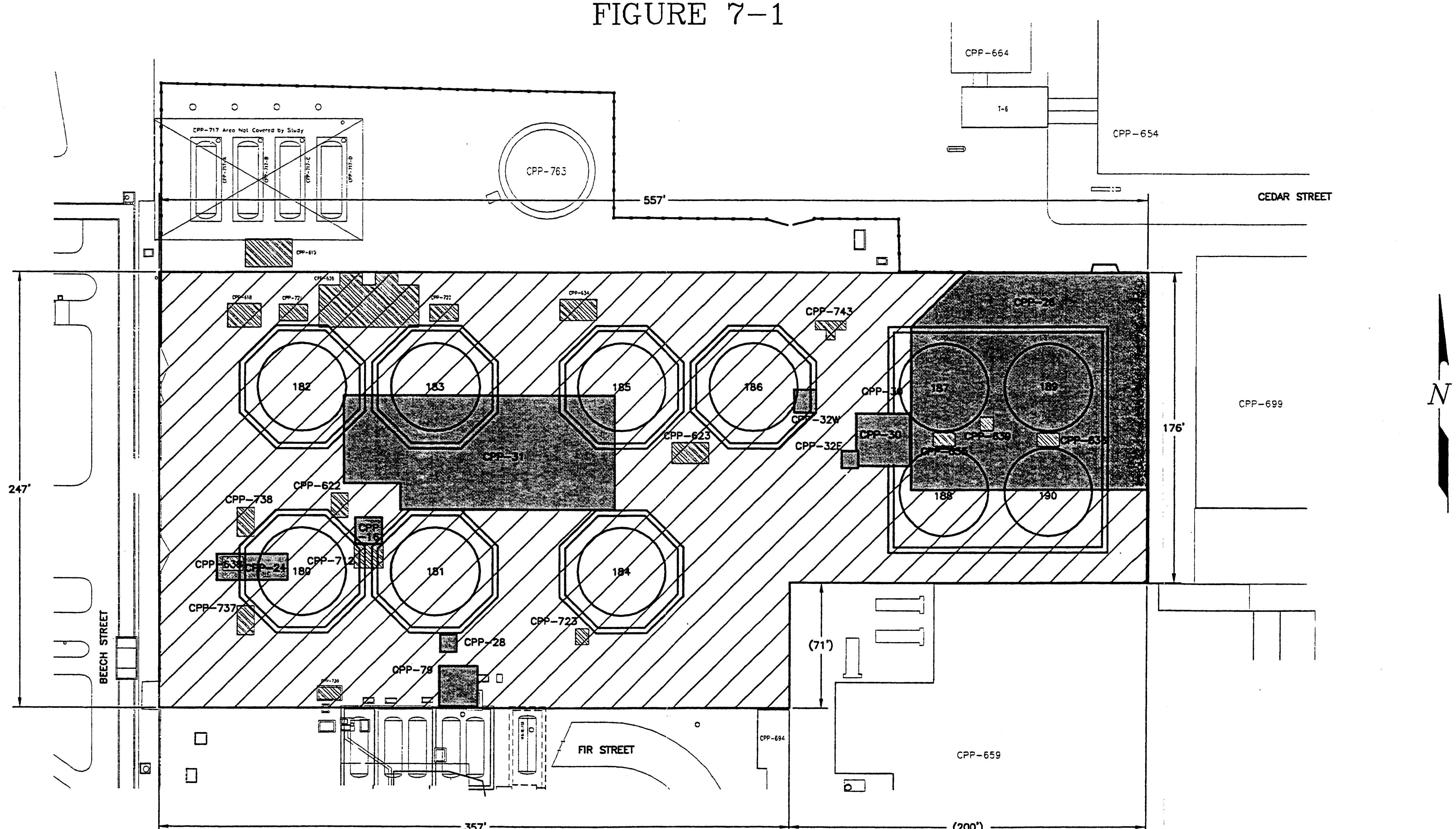
Upon completing TRCC under both the RCRA program (tanks, vaults, piping, auxiliary equipment, and soil contaminated during RCRA closure activities) and the CERCLA program (all of the soil in and around the TFF contaminated before initiating closure activities), no monitoring will be required at the TFF, as all contaminants will have been removed.

The following activities will have already taken place before physical TRCC can begin: Estimated Radiation Exposure Calculations, Air Emission Calculations, ALARA Review, System Operational Test, Operational Readiness Review, and a Hazard Analysis Review. In addition, a current Safety Analysis Report must be in place.

7.1.1 CERCLA/RCRA Integration Issues

The scope of work defined by the RCRA Program TRCC refers to the complete removal of buried tanks VES-WM-180 through VES-WM-190 (11 tanks), their associated vaults, piping, pipe encasements,

PROPOSED TOTAL REMOVAL BOUNDARIES
FIGURE 7-1



REFERENCE: WINCO ENVIRONMENTAL RESTORATION, ICPP ENVIRONMENTALLY CONTROLLED AREAS REFERENCE GUIDE, DATED 2/28/92

BUILDINGS TO BE REMOVED BY RCRA PROGRAM

KNOWN RELEASE SITES – CERCLA PROGRAM SOILS

PROPOSED AREA OF ADDITIONAL, SLIGHTLY CONTAMINATED SOIL REMOVAL (PERFORMED BY THE CERCLA PROGRAM)

0 20' 40' 60' 80' 100'

(DO NOT SCALE OFF OF THIS DRAWING)

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
TOTAL REMOVAL CLEAN CLOSURE
PROPOSED TOTAL REMOVAL BOUNDARIES

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: ERIC E THOMAS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES
SEE DAR NO.
EFFECTIVE DATE:

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER 530 | DWG- | REV
SCALE: NONE | SHEET 1 OF 1

User: WTH
Date: 01/23/98 – 1:45 P.M.
File: Figure7-1.dwg
Path: E:\wth\TB-1525

auxiliary systems, and that soil contaminated during the RCRA closure activities. All other soils in and around the TFF that are removed will be classified and managed as part of the CERCLA remedial action, as approved by the ROD for the TFF RI/FS. Both RCRA and CERCLA actions will impact each other, thus careful integration of both projects is critical during the planning stages.

For the purposes of this TRCC study, it will be assumed that once the tanks have undergone "cease use," the RCRA Program will remove the heels from the tanks, one at a time. The tanks will then be isolated until all heels have been transferred to the heel receiver tank (Section 7.1.4), at which time decontamination & decommissioning (D&D) could begin. In parallel with the RCRA Program heel removal work, the CERCLA Program will remove the highly contaminated Environmentally Controlled Areas (ECAs) soils located throughout the TFF (Figure 7-1) and store or treat and dispose of them properly. These ECAs were identified in the WAG 3 Remedial Investigation and Feasibility Study.[7-1]

The slightly contaminated soils located within the TFF boundary, defined in Figure 7-1, will be removed from the excavation pit (by the CERCLA Program) and stockpiled under CERCLA management. The RCRA and CERCLA Programs will integrate their excavation efforts, as a majority of the soil (both ECA areas and slightly contaminated soil) cannot be removed without first removing RCRA components (concrete encasements, pilings, etc.), and a majority of the RCRA components are buried under CERCLA soil and thus cannot be removed without the integrated efforts of CERCLA.

Once the site is determined to be "clean," the CERCLA Program will backfill the excavation pit with those CERCLA soils that are deemed appropriate for backfilling. The RCRA Program will then provide the remaining backfill needed to bring the excavation pit to grade level. At this point, the management of the site will be left to the CERCLA program, as all of the contaminants will have been removed, thus meeting RCRA closure standards.

7.1.2 Site Characterization

Geophysical, radiological, chemical, and heavy metal site characterization must occur before any remediation/retrieval can take place. This is done in order to map the hot spots in the excavation site, as well as any buried obstacles. Geophysical characterization is especially important to initially locate potentially active equipment, such as pipes, that do not appear on facility drawings. The geophysical sensors will be chosen based on the soil characteristics of the site, the waste types involved, and the depth of the waste.

In regards to radiological characterization, assaying in the presence of multiple radionuclides requires a method of determining the relative individual radionuclide amounts. Thus a detector, or detectors, that can distinguish between the radionuclides present will be used to map the radiological hot spots before excavation. These maps will be used to determine whether remote excavation will be required.

Currently, there are no good data as to the concentration of VOCs contained in the tanks and/or pipes. The only sampling for VOCs that has been done involved steam jetting liquid out of the tanks and then sampling for VOCs. This sampling method dilutes and potentially delutes the actual VOC concentrations. VOC characterization will be done before any type of excavation activities taking place because of the toxicity and potentially explosive characteristics of some VOCs.

Heavy metal characterization will also be done before initiating any removal activities. The TFF soils have not been characterized for heavy metals in the past, but based on process knowledge, they could be present; thus heavy metal characterization is warranted (see Reference 7-2).

It is beyond the scope of this study to determine the exact type and number of sensors (geophysical, radiological, chemical, and heavy metal) required for the TFF characterization effort.

In order to accomplish the aforementioned characterization activities remotely, a deployment platform must be used. Technology Development has a digface characterization system that is either excavator or crane mounted using a terrain following, self-stabilizing deployment platform (developed by INEEL EM-50 and referred to as the Warthog). This system includes all of the sensors necessary to perform geophysical, chemical, and radiological characterization. It is assumed that this equipment will be made available for TFF removal activities. Before use, modifications will have to be made to the digface characterization system to add a heavy metal sensor, as currently it is not equipped for heavy metal characterization. For more information on the Technology Development characterization equipment, please see Reference 7-3. For the initial site characterization activities at the TFF, the characterization equipment will be mounted to an excavator.

The rate at which characterization can be done is independent of the deployment platform used. The sensors drive the scan rate. The radiation sensors typically have the slowest scan rate, which is 1 foot per second by a 3-foot swath. All of the sensors necessary to do geophysical, radiological, chemical, and heavy metal characterization cannot be deployed at the same time using the Warthog, thus time will have to be provided to do each map (geophysical, radiological, chemical, and heavy metal) separately.

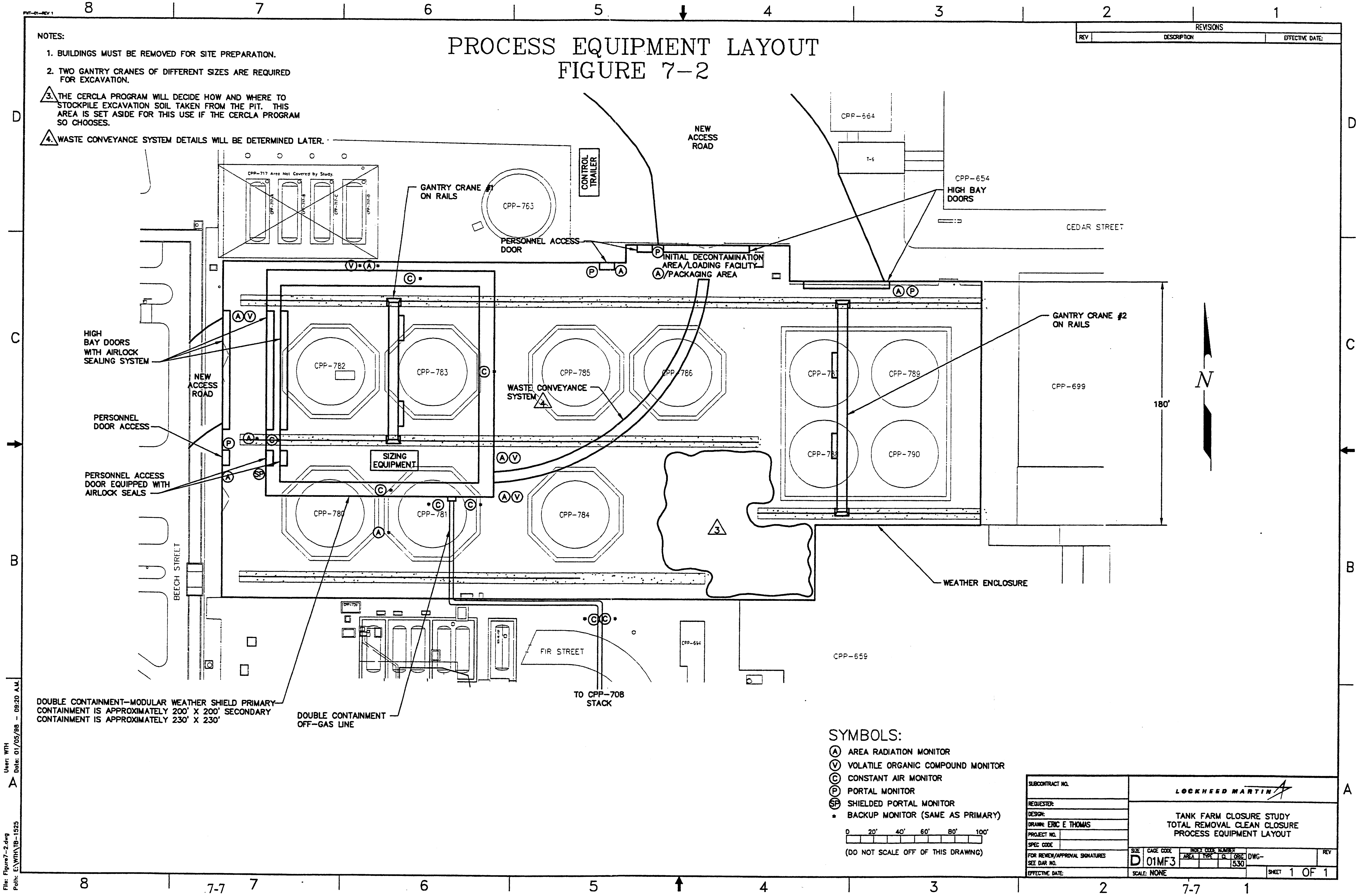
It should be noted that in order to use the Technology Development digface characterization system, the control system will have to be integrated with the TFF removal equipment supervisory control system.

7.1.3 Site Preparation - Phase I

7.1.3.1 Weather Enclosure. Once the initial characterization had taken place, a preengineered metal enclosure, with vertical metal siding and a pitched roof, will be set up to serve as a weather enclosure over the entire TFF to allow year-round closure operations. Footings (the exact type to be determined at a later date) would be installed before erecting the building. The weather enclosure height (100 feet) must facilitate the gantry cranes and double containment structures required during the removal action. The main portion of the enclosure will be approximately 260 feet by 360 feet. An extension on the east side of the enclosure will be approximately 180 feet by 200 feet (see Figure 7-2). These dimensions are based on the proposed area of soil removal given in the CERCLA Program WAG 3 Remedial Investigation Feasibility Study (Reference 7-1). The outer dimensions were increased slightly to allow for the additional equipment needed during the RCRA Program work. Both CERCLA and RCRA work will be performed within this larger weather enclosure.

High bay doors will be installed at the west end of the weather enclosure, towards Beech Street, to provide construction access. These doors will be sized such that the smaller gantry crane (see Figure 7-2) can be moved in and out of the enclosure more easily. A second high bay door will be required directly north of storage tanks VES-WM-187 through VES-WM-190 for the mobilization and demobilization of the second gantry crane.

PROCESS EQUIPMENT LAYOUT
FIGURE 7-2



A personnel access door will be installed in close proximity to each high bay door. Several emergency exit doors will be located throughout the building. Normal access will be restricted to the two main personnel access doors.

A standard heating and ventilation system will be required on the weather enclosure, as operations, maintenance, radiation technicians, etc. will occupy the building year round. The effluent from the building will be monitored to detect any releases to the environment. Early release detection can mitigate expensive delays and fines during operations.

A fire protection system will be required for the weather enclosure.

Two-dimensional and three-dimensional pan/tilt camera units will be installed inside the weather enclosure to facilitate the operations of D&D equipment. Lighting will be required on the cameras, in addition to general lighting throughout the enclosure.

The double containment, gantry cranes, sizing equipment, conveyance equipment, and soil stockpile area will all be located inside the weather enclosure.

7.1.3.2 Control Trailer. A portable, single wide control trailer would be located just north of the weather enclosure to house the operational controls, communications equipment, collision avoidance equipment, and personnel necessary for remote operations.

In order to reduce human error during remote D&D activities, the trailer and its equipment would be designed according to human engineering principles. By using human engineering design criteria, the potential for collisions within the weather enclosure and double containment, or other potential "accidents," would be reduced.

The control trailer design would be based on a system already designed by INEEL engineers to encompass remote gantry cranes, excavators, and conveyance systems. See Reference 7-4 for more details on the control trailer design and considerations.

7.1.3.3 Utilities. Utilities at the TFF must be modified to support heel removal from the tanks and D&D activities. Since the TFF will be totally removed, an electrical substation must be installed near the site. This substation will be similar to the equipment that was proposed by the WAG 3 FS Alternative Cost Estimate Project (Reference 7-1). Electricity will be required for the control trailer, weather enclosure, heavy equipment, and secondary equipment (i.e., sizing, separation, and transfer). The size of the substation has yet to be determined.

Water supplies to the TFF would require modifications, as water would be necessary during jet-grouting, decontamination, and heel removal operations. Potable water would also be necessary for the control trailer.

Steam may be necessary for cleaning the tanks during heel removal. As a result, minor modifications will be made to access steam pipes from the surface of the TFF. New piping would be tied to the existing systems and routed around the excavation site, as the existing piping within the proposed excavation area may be breached during the CERCLA Program work being done to remove the ECA soils.

Regulations for the weather enclosure may require the system to vent at the CPP-708 stack. Should this be necessary, HVAC lines will be made to the VOG system at the TFF. New piping would be necessary for the connection between the building and the existing VOG piping.

Waste transfer lines would be necessary to facilitate decontamination of heavy equipment and end-effectors. This piping would transfer any captured flushing or decontamination fluids that may be used throughout the duration of the project. These lines would run from the decontamination equipment to the PEWE, or possibly the NWCF, for waste fluid processing.

7.1.3.4 Monitoring Equipment. Monitoring equipment would be necessary during the installation, operation, and demobilization of equipment being used for heel removal and D&D activities. The monitoring equipment shall be capable of monitoring alpha and beta radiation, VOCs, and heavy metals, in addition to any other monitors deemed necessary by the Safety Analysis Report and cognizant safety professionals.

Constant air monitors (CAMs) measure airborne alpha and beta contamination and are recommended for the following areas:

1. Four monitors in the annulus area between the primary and secondary double containment enclosures (one per side)

2. Two in the weather enclosure near the exhaust system intakes for the double containment

3. Two effluent monitors, or stack CAMs, in the line running between the double containment structure and the CPP-708 stack.

Redundant CAMs are also needed for each location due to safety concerns (see Figure 7-2).

Area radiation monitors (ARMs) shall be located on each side of the double containment within the weather enclosure (see Figure 7-2). These ARMs would monitor the radiation levels just outside the secondary containment structure to detect leaks, indicating a loss of secondary confinement. Additional ARMs would be located at each personnel exit. Redundant ARMs would be required for each location due to safety concerns.

Automated personnel monitors (APMs) shall be located at the personnel exits from the weather and double containment enclosures. This equipment would reduce the potential spread of contamination,[7-5] as well as provide personnel safety. Redundant APMs are not necessary, as a portable frisker may be used when the APM is not functioning. Shielding may be required on the APM at the exit from the double containment, as the background radiation levels may be too high for the monitors.

In addition to the above instrumentation, project specific portable health physics instrumentation would be required during operations. These items would include custom instruments, extendable probes, portable shielded detectors, remote reading dosimeters, etc. For more information on the required monitoring equipment, see Reference 7-5.

7.1.3.5 Decontamination Equipment. A decontamination station would be required to decontaminate equipment for maintenance purposes, as well as to minimize the potential spread of contamination. Because of the integrated efforts between the RCRA and CERCLA Programs and the limited space on the TFF, it is assumed that the decontamination station used for the CERCLA Program work can also be used for the RCRA Program work. See Reference 7-1 for more information on the decontamination station. Modifications to the decontamination station would be necessary to accommodate a hot water bath system to remove the paraffin-based grout from the end-effectors on the crane, or any other equipment used to excavate soil encapsulated in paraffin-based grout.

7.1.4 Heel Removal

Once Phase 1 Site Preparation has been completed, the tank will be isolated from the existing TFF by cutting and capping interconnecting lines; the heel will be removed from each tank as much as possible and transferred to a heel receiver tank, and a washing/agitating/flushing/pumping type process will be done on each tank and associated piping, and the tank will be dried. TRCC activities will not begin until all 11 tanks have undergone heel removal and the final heel left in the heel receiver tank has been removed and disposed of.

ICF Kaiser prepared numerous documents on heel removal activities, including, but not limited to, tank isolation, tank washing and agitating operations, and tank drying operations. For further information on these activities, please refer to References 7-6 through 7-9.

In parallel with the heel removal work, the CERCLA Program will remove the highly contaminated soils located in the ECAs. At this point, the site is ready for D&D activities to begin.

7.1.5 Site Preparation - Phase II

7.1.5.1 Decontaminate and Decommission (D&D) Buildings and Tank Risers. In order to perform underground D&D activities at the TFF, the surface of the TFF must be cleared of existing buildings, tank risers, valve boxes, and control pits. Removal of these items would facilitate the deployment of overburden removal equipment and would allow for the jet-grouting of subsurface cement walls (for structural stability) and a paraffin-based grout (for contamination control purposes.)

It is predicted that due to the anticipated radiation levels in the TFF, both manual and remote operations will be necessary.

A manually operated excavator would be used for conventional dismantlement of the buildings and structures sampled and confirmed to be clean. The excavator would be fitted with a variety of end-effectors including, but not limited to, concrete pulverizers, concrete cracking jaws, shear jaws, and plate shear jaws to break, crack, and lift large sections of rebar reinforced concrete. See Reference 7-10 for more information.

The excavator would section off large pieces of the structures, load the sections into a dump truck for transport to the Central Facilities Area (CFA) landfill, where they would be disposed of as industrial, uncontaminated solid waste (see Section 7.1.7). Those structures that have been sampled and confirmed as low-level, contact-handled radioactive waste would require packaging in approved containers. In this case, the excavator would size the concrete or steel objects ripped from the structure using shears, chop saws, etc. The sized sections could then be placed in approved shipping containers for shipment to an approved disposal or storage facility (see Section 7.1.8).

Remote operations would be necessary during abovegrade D&D activities at the TFF for those structures characterized and found to be highly contaminated. Because of leaks in process waste lines over the years, high radiation concentrations may be encountered in valve boxes and in or under buildings. As a result, it is assumed that operations will be conducted in an environmentally controlled structure, such as a standard plastic tent under negative pressure. The structures to be dismantled would be sized by a remotely operated excavator equipped with sizing end-effectors, such as concrete pulverizers, concrete cracking jaws, and shear jaws. The sized waste would then be packaged into approved waste containers for shipment (see Section 7.1.8).

Currently, there are no methods of remote packaging available. A system to remotely package the sections into waste containers would have to be designed, or personnel would be required to do the work. If personnel are required, special consideration must be given to shielding requirements to minimize the exposure levels. See Table 7-1 for a listing of the items to be removed, and the method of removal (manual or remote).

Considerations for overstressing and failing the tank vaults must be made. A complete analysis of the tank vault stresses must be completed and the equipment approved before D&D can begin. Smaller excavators (allowing for the required hydraulics to operate the end-effectors) would be used to lower stresses on the vaults.

7.1.5.2 CERCLA Integration. For the purposes of this study, it is assumed that all soil moved or removed during RCRA TRCC activities will be done by CERCLA under CERCLA management. The soils will be disposed of as outlined in Reference 7-1. It is further assumed that the sampling and characterization needed during removal actions will be performed as an integrated effort between the RCRA and CERCLA Programs.

The cost estimates reflect the integration between the CERCLA Program and the RCRA Program. The costs are separated into RCRA Program costs, CERCLA Program costs, and shared costs, or those costs that would be shared between the two programs. It is assumed that the shared costs would be divided equally between the two programs. However, negotiations between the two groups would be necessary to determine the exact percentage each program would be responsible for.

7.1.5.3 Characterization and Sampling. Once the buildings and risers have been removed, characterization of the entire digface must be done. The same approach used for the initial characterization (see Section 7.1.2) will be used, excluding the geophysical characterization. Once the excavation activities are underway, the buried tanks, vaults, etc., will become exposed gradually, thus geophysical characterization is not deemed necessary more than once.

Conventional methods of sampling will be performed on the TFF before beginning removal actions.

Once the TFF has been characterized, and the hot spots mapped accordingly, soil stabilization activities can begin.

7.1.5.4 Soil Stabilization. Because of the highly restrictive load limitations within the TFF (see Section 6.2), subsurface cement walls will be jet-grouted into the TFF, the type of cement to be determined at a later date. The exact location of the subsurface cement walls will not be determined until good characterization maps are available and the path of least resistance can be determined. Before jet-grouting, a remote excavator will be used to remove any piping, concrete encasements, etc. located in the areas where the subsurface walls are to be installed. It is expected that each wall will be approximately 6 feet wide and 50 feet in height, with the top of each wall being at grade level and

Table 7-1. Component removed and assumed waste classification.

Component	Assumed Waste Classification
Tank roofs – stainless steel	Mixed waste – contact handled
Bottom of vaults – concrete	Radioactive waste - remote handled
Side panels, columns, and beams of the vault – concrete	Uncontaminated solid waste - (noncompactible, nonconditional industrial waste)
Sump pumps (steam jets) – stainless steel	Mixed waste – remote handled
Process piping - stainless steel	Mixed waste – remote handled – 50%[c] Mixed waste – contact handled – 50%[c]
Stainless steel liner in the concrete encasements	Mixed waste – remote handled – 50%[c] Mixed waste – contact handled – 50%[c]
Concrete encasements	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) - 85% Mixed waste – remote handled - 15%[a]
Pilings – steel encased concrete	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) - 67% Mixed waste – remote handled - 33%[b]
Tank Riser – concrete portion	Radioactive waste - contact handled
Tank Risers – stainless steel liner	Mixed waste – remote handled
CPP-635, CPP-636 - Transcite siding containing asbestos, framed with steel CPP-623, 628, 631, 632, 635, 638, 712, and the valve boxes - mainly cinderblock	Radioactive waste – contact handled – 50%[c] Radioactive waste – remote handled – 50%[c]
CPP-618, 619, and 634 – mainly cinderblock	Uncontaminated solid waste (noncompactible, nonconditional industrial waste)
CPP-738 (underground condenser pit)	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 75%[d] Radioactive waste - remote handled – 25%[d]
Rubber membrane	Radioactive waste – incinerable, contact handled
Duct bank for Radiation Monitoring Lines – concrete	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 83% Mixed waste – remote handled - 17%
Cooling coils in eight out of 11 tanks – stainless steel	Mixed waste – remote handled
Tanks – stainless steel	Mixed waste – remote handled

Table 7-1. (continued).

Component	Assumed Waste Classification

a. 15% of the encasements are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.

b. 33% of the pilings are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.

c. Sampling and characterization would be performed on these structures before removal to ascertain whether or not some portions could be shipped as uncontaminated solid waste. Assume that approximately half of this material can be decontaminated sufficiently before shipping to be contact handled.

d. D. Machovec, Tank Farm expert, stated that the building will mainly be uncontaminated solid waste; the only portion that will be radioactive waste will be the outside walls.

e. 17% of the duct banks are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.

running the length of the TFF. These walls will serve as the structural support for the gantry cranes that will be used during retrieval activities, as well as the double confinement enclosures. It is expected that four walls of varying lengths (560 feet, 200 feet, and two @ 360 feet) will be required to support the rail system for the gantry cranes (see Figures 7-3 and 7-4). An analysis will have to be performed before jet-grouting the cement walls to determine loading restrictions and adjust wall parameters accordingly.

A jet-grouting apparatus consisting of a drill system, high-pressure positive displacement pump, and associated supply tanks and high-pressure hoses will be used to create the walls. The drill stem will be driven into the excavation pit and jet-grouted at 6,000 psi, while at the same time withdrawing the drill stem in 5-cm incremental steps. This wall thus created will be composed of 67% soil and 33% cement material. Using these parameters, there will be no visible voids in the wall, which will support a 98,000-lb excavator in the excavation position on the wall. In the excavation position means that the excavator will be sitting on the edge of a vertical, abovegrade excavation pit. The wall will not undergo any structural damage, thus the walls should support the gantry cranes (see Reference 7-7).

Additional footings for the double containment structures discussed in Section 7.1.6.1.2 may also be jet-grouted into the TFF Area.

7.1.6 D&D Activities

7.1.6.1 Contamination Control.

7.1.6.1.1 Paraffin-Based Grout—Fugitive dust control is critical since alpha contamination is expected in the soil matrix at the TFF. This is because alpha contaminants adhere to soil particles readily, which then become airborne. These microscopic dust particles are then spread easily throughout the excavation area, resulting in added exposure pathways, as well as making decontamination activities much more difficult. For these reasons, contamination control should occur as close to the source as possible. In researching the different methods of contamination control, the only method that actually controls the dust/contamination at its source is in situ stabilization. There are several methods of in situ stabilization — some have not been field tested, and none are known to work in all soil types. It must be assumed that field tests will be conducted at the TFF before the dust control jet-grouting media would be selected.

GRADE PREPARATION AND JET-GROUTING
FIGURE 7-3

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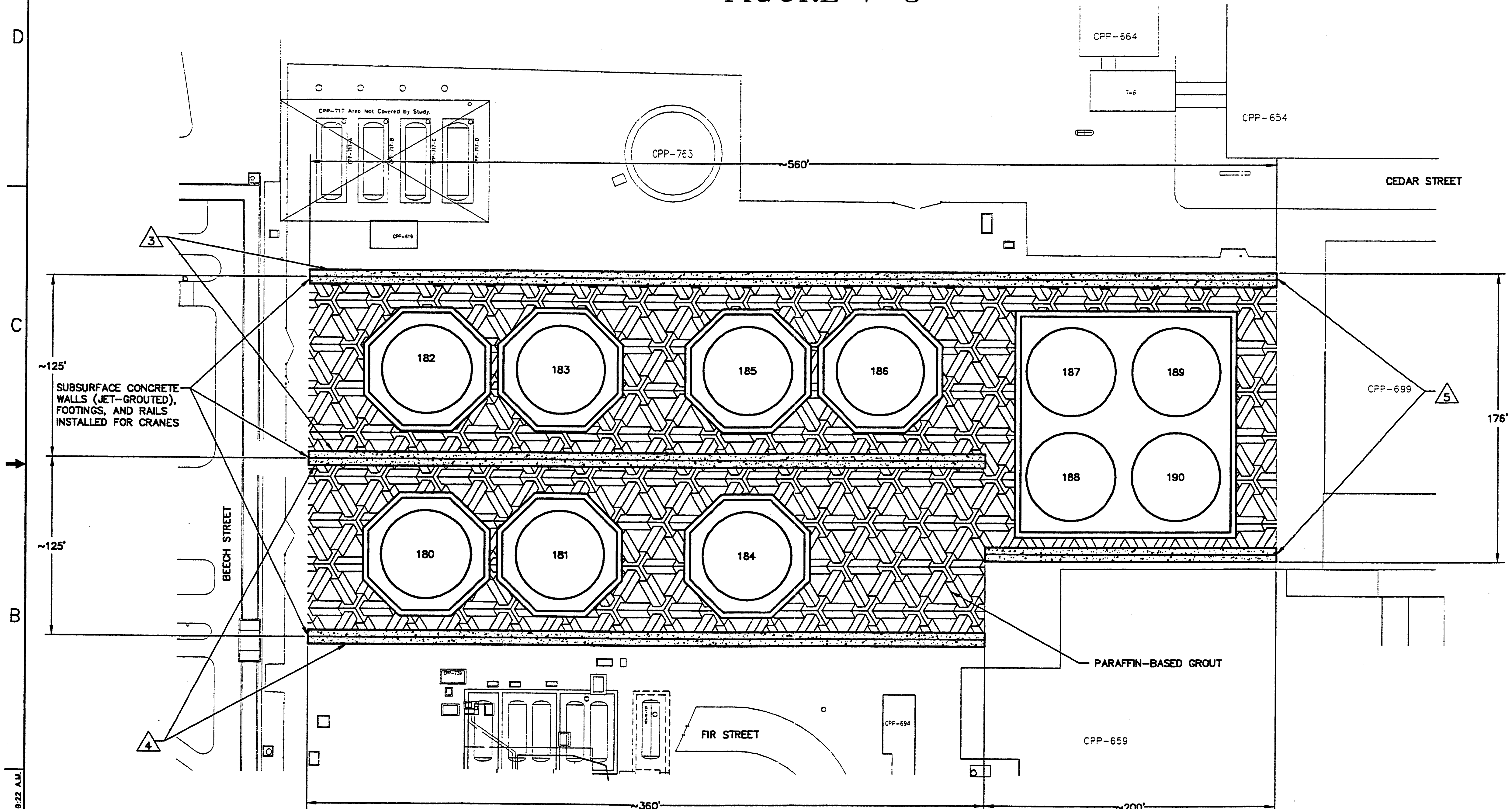

NOTES:

1. BUILDINGS MUST BE REMOVED FOR SITE PREPARATION.
2. TWO GANTRY CRANES OF DIFFERENT SIZES ARE REQUIRED FOR EXCAVATION.

3. NORTH TRACK FOR GANTRY CRANE #1.
4. SOUTH TRACK FOR GANTRY CRANE #1.
5. TRACK FOR GANTRY CRANE #2.

0 20' 40' 60' 80' 100'
(DO NOT SCALE OFF OF THIS DRAWING)

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: ERIC E THOMAS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
TOTAL REMOVAL CLEAN CLOSURE
GRADE PREPARATION AND JET-GROUTING

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER AREA TYPE Q ORG 530 | DWG- | REV
SCALE: NONE | SHEET 1 OF 1

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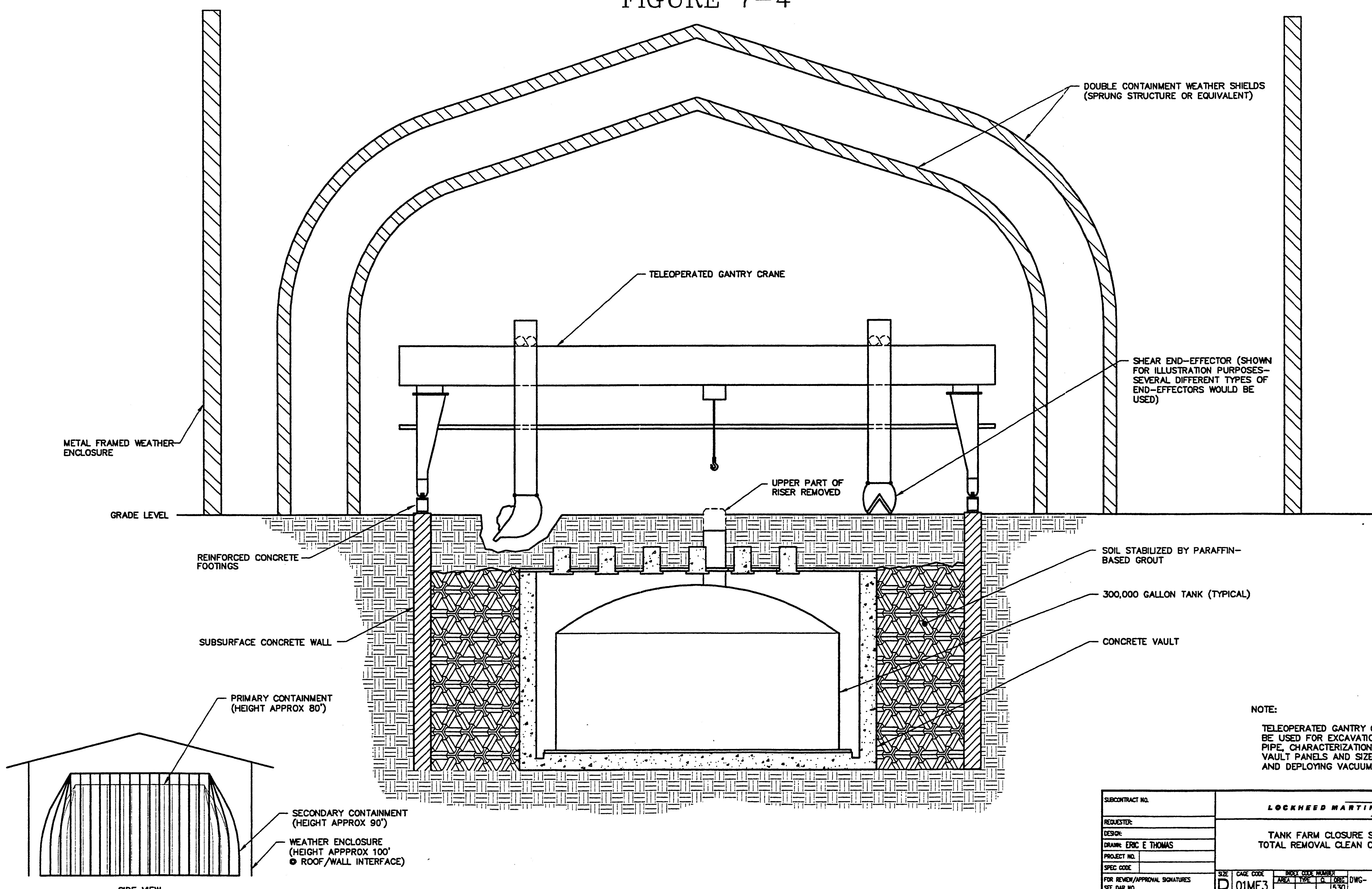
ENCLOSURE AND GANTRY CRANE LAYOUT
FIGURE 7-4



NOTE:

TELEOPERATED GANTRY CRANES WILL BE USED FOR EXCAVATION, REMOVING PIPE, CHARACTERIZATION, LIFTING OUT VAULT PANELS AND SIZED OBJECTS, AND DEPLOYING VACUUM UNITS

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	
DESIGN:	TANK FARM CLOSURE STUDY TOTAL REMOVAL CLEAN CLOSURE
DRAWN: ERIC E THOMAS	
PROJECT NO.	
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D CAGE CODE 01MF3 INDEX CODE NUMBER 530 DWG- REV
EFFECTIVE DATE:	SCALE: NONE SHEET 1 OF 1

User: WTH Date: 01/01/98 - 3:29 P.M.
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For this study, it is assumed that a paraffin-based grout will be jet-grouted into the excavation pit before any removal activities taking place at the TFF. This grout would then form a first line of defense against dust creation. Field tests at the INEEL have indicated that a paraffin-based grout is 99% efficient in dust control, as it permeates the surrounding ungrouted soil as well the grouted soil, resulting in all contents of the pit, both soil and waste, being saturated with paraffin-based grout (Reference 7-11). Refer to Figure 7-4 for the relative position of the jet-grouted matrix in relation to the tanks.

Using a paraffin-based grout not only controls fugitive dust at its source, but also minimizes waste volume, as the grout seeps into the void spaces in the soil. The paraffin-based grout then cures, and can be excavated in malleable chunks using standard equipment. This material is suitable for use in transuranic and radioactive-contaminated waste sites. In addition, the paraffin-based grout has a low melting point [60°C (140°F)], thus it can be removed easily from the soil/grout matrix before treatment. For the purposes of this study, it will be assumed that RCRA will remove the paraffin-based grout before CERCLA stockpiling/disposing of the excavated soil.

The paraffin-based grout is injected in the same manner as the subsurface concrete walls discussed in Section 7.1.5.4.

After completing all jet-grouting activities, the two will be installed in the weather enclosure (see Figure 7-2). This will be done after placing the gantry cranes rails and rail footings on the subsurface cement walls discussed in Section 7.1.5.4.

7.1.6.1.2 Double Containment—Because of the presence of alpha contamination at the TFF during retrieval activities, it is assumed that double containment will be required at this point in the TRCC process. The primary containment will consist of a lightweight, highly portable weather shield, measuring 200 feet by 200 feet, rather than a conventional building due to ground pressure concerns at the TFF. The secondary containment will also be a weather shield, measuring 230 feet by 230 feet. Optimally, these structures should be modular to allow easy setup and takedown within the larger weather enclosure. These structures will initially be set up over the first two tanks to be removed (see Figure 7-2).

In order to have double containment, a negative pressure must be maintained between the primary and secondary containment. This area between the two structures is referred to as the annulus area, and must be monitored continuously. A loss of boundary containment would result if the negative pressure is not maintained. This leads to air releases and regulatory compliance issues. Because of the significant safety and cost issues associated with the loss of a double containment boundary, the ventilation system on a double containment structure consists of both redundant HEPA filters and activated carbon filters on the primary and secondary containment buildings. The HEPA filters will be of a nuclear grade bag-in, bag-out type and, when loaded, can be incinerated.

In conjunction with the double containment, the ventilation systems in both the double containment and the weather enclosure would be set up such that air flow is always towards a higher contamination level zone (from "clean" to "dirty" zones). An airflow model would be done after the design of the double containment and weather enclosures to ensure adequate air flow, proper direction, and sufficient monitoring is supplied.

Fire protection systems will be incorporated into the design of the double containment structures due to the possibility of VOCs, and the presence of molten paraffin-based grout.

A breathing air system will be incorporated into the double containment system due to the hazardous environment expected during maintenance activities. Remote operations will be conducted the majority of the time, however, entries into the double containment may be required on occasion.

7.1.6.2 Remote Vision. Conventional D&D work does not require a lot of remote equipment, as the waste can be contact handled safely. Because of the high dose rates expected during the actual removal of the tanks, vaults, piping, etc., remote D&D will be required. A remote vision system must be used in order to facilitate remote operations. A combination of stereoscopic and 2D cameras and monitors located on the excavation equipment and in the double containment will be used during the removal activities, as they have proven to produce high throughputs when performing remotely operated activities. They allow the operator freedom within the control environment, and provide almost simultaneous visual feedback of all the video sources. Many tasks have been shown to be extremely difficult using two-dimensional cameras, but were not difficult when using stereoscopic vision (Reference 7-11).

7.1.6.2.1 Secondary Contamination Control—The double containment structures and jet-grouted, paraffin-based grout would be considered the primary line of defense in the struggle for contamination control. Several other secondary methods of contamination control could also be employed in accordance with the aggressive contamination control strategy deemed necessary for the TRCC activities. These methods include soil fixants, mats and tarps, water misters, and foams, to name a few.

A soil fixant will be applied on all traffic areas within the weather enclosure and double containment to further minimize the airborne dust associated with vehicle traffic. This would be applied using the INEEL Contamination Control Unit (CCU). The CCU was specifically developed by the INEEL to suppress and fix contamination, and inhibit its spread during retrieval operations of buried wastes that are normally quite dusty. The CCU, a field-deployable, self-contained unit is capable of dispensing soil fixatives, dust suppression agents, and misted water. This unit would be an asset during the retrieval operations at the TFF. For more information on the CCU, see Reference 7-11.

Natural polysaccharides would be sprayed on the vertical walls of the excavation pit using the CCU to help keep the walls from eroding and to minimize dust.

Mats/tarps would be put down around the excavation site for the retrieval equipment to keep the equipment from coming into contact with the soil.

7.1.6.3 Overburden Removal—Once the contamination control equipment is in place, excavation can begin. First, the overburden soil will be removed. It is assumed that the CERCLA Program will handle any soil activities on the TFF site, thus the CERCLA Program will remove the overburden. As the overburden is expected to be clean, it will be stockpiled to be used as backfill later, if analysis confirms it meets regulatory compliance for clean soil.

After excavating approximately 6 inches of soil, the Dupont membrane covering the TFF will be exposed. This membrane should be cut and stripped into pieces, packaged in waste storage boxes as incinerable waste, and disposed of appropriately (see Section 7.1.7). The membrane is a heavy rubber, much like an inner tube, and covers the entire TFF Area (see Reference 7-2).

Soil removal will continue to a depth of approximately 4 feet, at which time a vacuum hose with an air-jet end-effector to break up the moist soil will be used to remove soil from around the piping and encasements. This will take an integrated effort between RCRA and CERCLA to accomplish. The duct banks, encasements, and other buried objects will then be removed. All piping that enters or exits the proposed area of excavation (see Figure 7-1) will be cut, grouted, and capped. Piping outside of the weather enclosure will not be excavated.

Characterization will be performed approximately every 3 feet due to the sensitivity of the various sensors (radiological, chemical, and heavy metal) using the characterization system discussed in Section 7.1.2. The sensors required to perform characterization of the site will be mounted to the gantry crane being used for below grade D&D activities, thus time must be allotted for equipment setup and takedown each time characterization is to be done.

7.1.6.4 Piping, Pilings, and Concrete Encasements. Once the overburden and rubber membrane has been removed, the process piping concrete encasements and pilings will be exposed. In addition, process piping, cooling water, vessel offgas (VOG) piping, electrical lines, radiation monitoring instrumentation, high pressure steam pipes, etc., are all buried under TFF surface.

In order to minimize the size of the double containment required, only two tanks, with all of the associated soil, piping, concrete encasements, piles, etc., will be excavated at a given time. As a result, one excavation pit will be created at a time. The pits may not be backfilled until the entire TFF has been removed. After two tanks have been remediated, the double confinement and gantry crane will be relocated to the next set of adjacent tanks. The crane located on the west end of the weather enclosure must be relocated to the southern tracks after Tanks VES-WM-182, -183, and -185, have been removed (see Figure 7-6).

Process piping at the TFF is enclosed in concrete encasements for structural support and to prevent any contaminants from being released into the soil. These pipe encasements are placed atop a concrete pile cap, which in turn, sits atop the piles. There are approximately 310 piles buried at the TFF, each placed every 5 feet. The piles are 10 inches in diameter, 30 feet long, and filled with concrete. See Figure 7-6 for a sketch of a typical pipe encasement and pile.

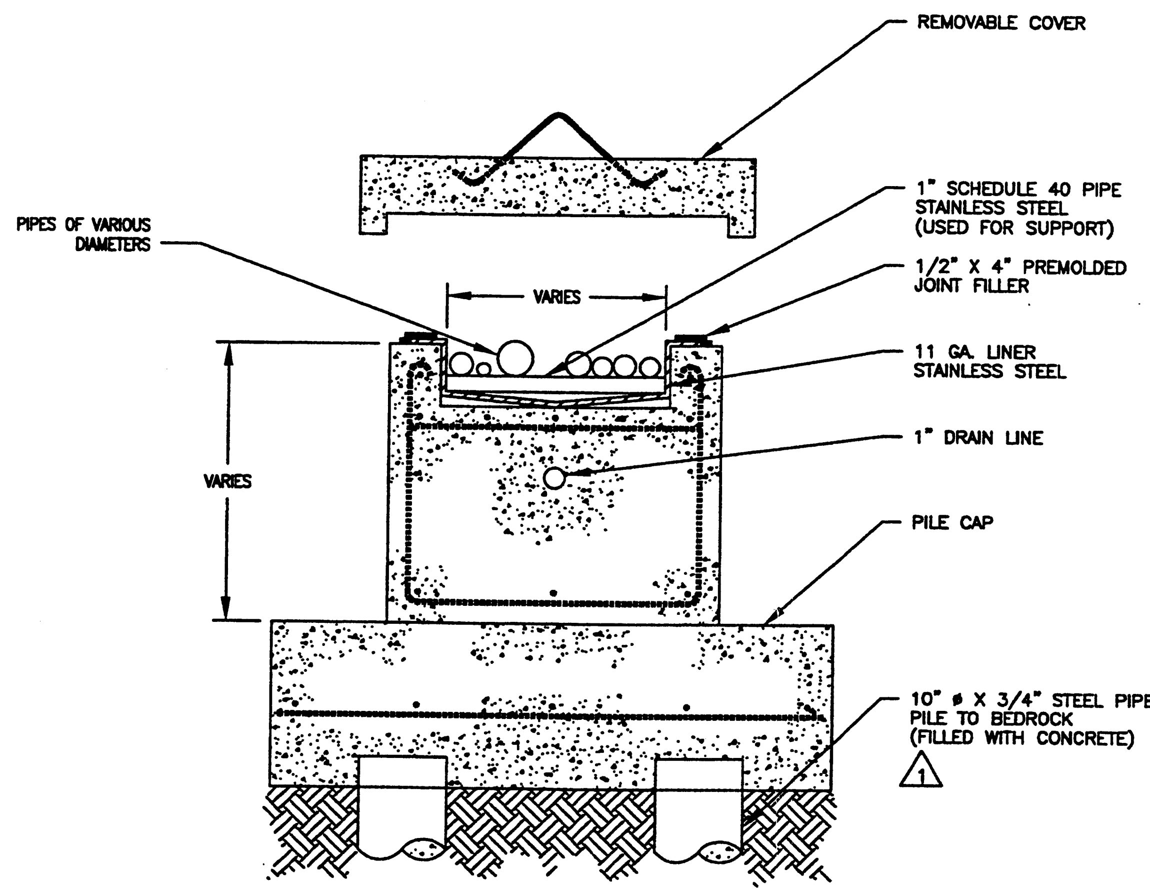
The pipe encasements are made of concrete, reinforced by #5 rebar. Inside the encasement is an 11 gage stainless steel liner, which prevents the encasements from becoming contaminated should a leak occur in the piping. The pile caps and encasement caps are also made of concrete that is reinforced by rebar.

The piles are not physically attached to the pile caps by rebar, but are rather set on top of the piles, with the piles fitting into prefabricated holes in the caps. The piles only penetrate half way through the pile caps.

The pile caps themselves are attached to the pipe encasements with rebar. When the encasements are attached to the pile caps in this fashion, it is difficult to simply lift the encasements from the pile caps. As a result, the teleoperated gantry crane must remove both the pile cap and encasement at the same time. The sizing end-effectors will then size the encasements for shipment.

The steel liner within the encasements is welded to the encasements by "lugs" that were set into the concrete. Removal of the liner would require these welds to be broken or sheared. A method for accomplishing this remotely would have to be developed.

STAINLESS STEEL LINED CONCRETE ENCASEMENTS AND PILES
FIGURE 7–5



SECTION OF TYPICAL CONCRETE ENCASEMENT

NOTE:

1. PILES RUN FROM THE BOTTOM OF THE PILECAP TO THE BEDROCK LAYER. (APPROXIMATELY 30 FEET)

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	
DESIGN:	TANK FARM CLOSURE STUDY
DRAWN: ERIC E THOMAS	TOTAL REMOVAL CLEAN CLOSURE
PROJECT NO.	STAINLESS STEEL LINED CONCRETE ENCASEMENT AND PILES
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D, CAGE CODE 01MF3, INDEX CODE NUMBER 530, DWG-
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The piping located within the encasements is not "encased" in concrete. When the encasement caps are lifted off of the encasements, the piping is accessible. However, some junction boxes have short sections of tile encased piping that are currently abandoned (old style of encasements). The approximate length of these encasements is half of a mile. Most of the original tile encasement has been removed. See Reference 7-12 for the take-off values calculated for the piles, encasements, and piping.

Once the encasements have been uncovered, they can be lifted off with the gantry crane's hoist by using the existing lifting eyes. This will expose the piping within the encasements. A sizing tool such as the LaBounty® concrete pulverizer, which does not produce high heat or electrical sparks that would cause explosions due to the presence of VOCs, will then be deployed by one of the z-masts (motorized rigid arms that extend and retract vertically on the crane to deploy end-effectors) attached to the gantry crane to section off lengths of the encasement. The other z-mast can then deploy a grapple end-effector or bucket to retrieve the sectioned portion of the encasement. Care must be taken to ensure that the gantry crane z-mast and grapple are fully capable of lifting the required loads.

After a section of the encasement has been removed, it will be transported by the gantry crane to the sizing area, located within the double containment, for further size reduction. Engineering design is required to determine the sizing process for the stainless steel lined concrete encasements. The steel liner must be removed from the encasements without spreading contamination.

The pile caps can then be removed from the soil. The soil must be further removed in order to expose the piles, which are approximately 30 feet in length. To remove these objects, it will be necessary to remove a large portion of the surrounding soil. A vibratory pile extractor will be deployed from the crane's hoist to remove the pile. See Reference 7-10 for more information on the pile extractor. This tool is deployed from the hoist of a crane and attaches directly to the pile. Once attached, the extractor vibrates the pile while still in the soil. Because of the vibratory actions created by the extractor, friction between the piles and soil is significantly reduced. Thus, as the extractor vibrates, a crane is able to remove the pile vertically. A vibratory pile removal tool similar to the H&M Model 1700 Vibratory Driver Extractor (manufactured by Hercules Machinery Corporation) will be used for pile extraction. The pile may be sectioned into halves or thirds as it is extracted to facilitate handling once the pile is removed. It should be noted that integration between the RCRA and CERCLA Programs will be critical at this point in the operations.

7.1.6.5 Piping Removal. To remove the piping that is not in the encasement trenches, the soil must first be removed from around the piping by using a vacuum/airjet end-effector (see Section 7.1.6.3). Next, the large hydraulic shear that is mounted on the gantry crane can section off lengths of piping. The grapple end-effector can then be used to remove the cut pipe for further size reduction. A vacuum allows soil to be removed in the immediate proximity of the piping without the possibility of breaking the piping.

7.1.6.6 Tanks and Vaults. The dismantling of the tanks and vaults will be accomplished remotely using a teleoperated gantry crane similar to one developed by INEEL engineers (Cooperative Telerobotic Retrieval System).

Tanks VES-WM-180 and VES-WM-181 are single poured concrete vaults, and Tanks VES-WM-187 to VES-WM-190 are in a 4-plex vault. These tanks must be excavated differently. Concrete pulverizers will be used to break these vaults into manageable pieces. More stringent contamination control methods may have to be employed to minimize the spread of contamination.

After the pipe encasement, piping, duct banks, and other buried objects have been removed from over-top of the TFF vaults, D&D activities for the tanks and vaults will commence.

Excavation of the soil will continue to a depth of approximately 10 feet belowgrade. At this point, the vault roofs and piping coming through the top and sides of vault will be exposed.

The following excavation order pertains to the pillar-panel vaults associated with Tanks VES-WM-182 to VES-WM-186. The top of the pillar-panel vault, which consists of T-beams and concrete panels, will be removed by the crane. The T-beams are structural precast members, drilled and tapped for eyebolts. The roof panels, made of 3,000 psi concrete, are located between the T-beams. In order to remove the vault panels and T-beams, new lifting eyes will be installed, as the old lifting eyes may be unsafe.

Once the vault roof has been removed, the top of the tank itself will be exposed. Using the LaBounty® Plate Shear, the top portion of the tank would be sectioned and removed in 4-foot vertical sections. See Figure 7-5 for a drawing of the tank and vault D&D activities.

As the sections of tank are removed, the vault sections that correspond to the tank depth will remain in place to provide shielding. The cooling coils within the tanks will be sectioned off at the same time as the tank and will not be separated from the tank wall.

After two 4-foot sections of the tank have been removed, the vault panel at this depth (each panel is 7 feet 11-½ inches high by 8 feet 10 inches wide by 6 inches thick and lies vertically) will be removed. New lifting eyes may be required on the panels to lift them out. Each of the 64 concrete panels is bolted to the vault pillar using four carbon steel, 3 inches by 11 inches by 3/8 inches thick straps with two bolts per strap. These straps must be sheared. As the excavation progresses, new straps may have to be attached to prevent other vault panels from falling into the tank. Panels should remain in place until the corresponding tank section has been removed. This will provide some shielding during the operation. When the panel is removed by the crane, it will be placed in an area designated for size reduction within the double containment. Concrete pulverizers would most likely be used for this sizing operation.

After the vault panel has been removed, another section of the tank will be cut and removed. This process will be continued until the bottom of the tank is exposed. The vault is four panels high, and is 38 feet 9 inches from the bottom of the concrete pad to the top of the T-beam.

Tanks 180 and 181 are bolted to the floor of the vault and will require bolt-shearing activities for removal. The bottom of tank consists of 5/16-inches plate with a 4-inches curb. These were molded at the factory and formed into the "knuckle region" of the tank. The tank is 21 feet to the tangent of the dome and 29 feet 6 inches to the top of the dome. The manway is another 1 feet 6 inches above the dome (see Figure 7-5).

Once the roof beams, roof panels, side panels, and tanks have been removed, the large vertical columns can be used to support the vaults retrieved. These beams will be sectioned into two or three pieces to facilitate handling outside of the excavation pit. The vault floor will also be excavated during this time.

TANK AND VAULT DEMOLITION
FIGURE 7-6

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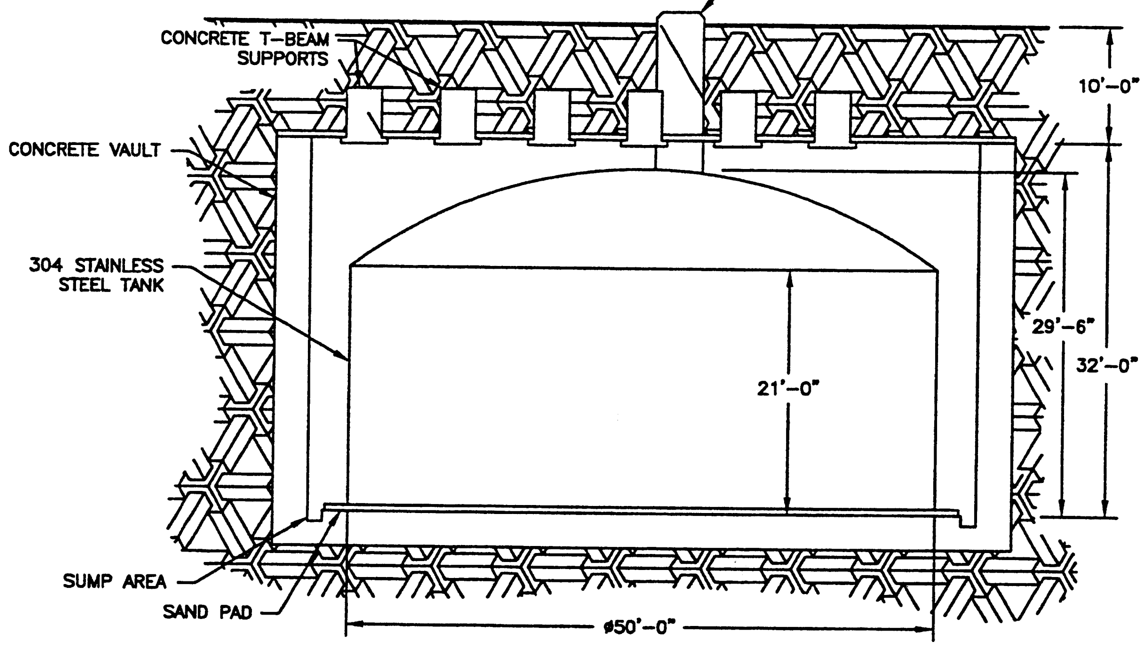
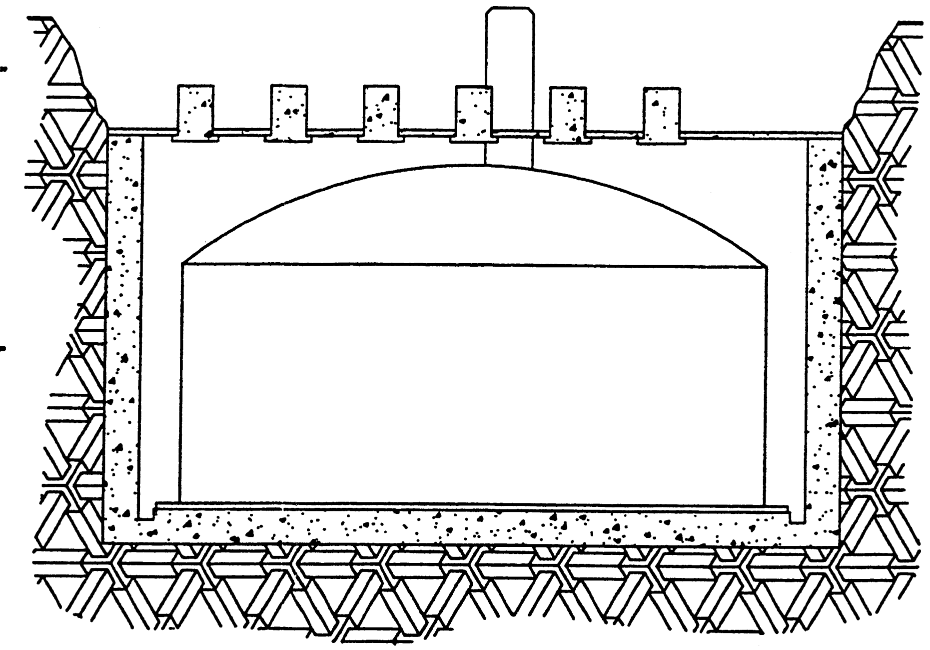
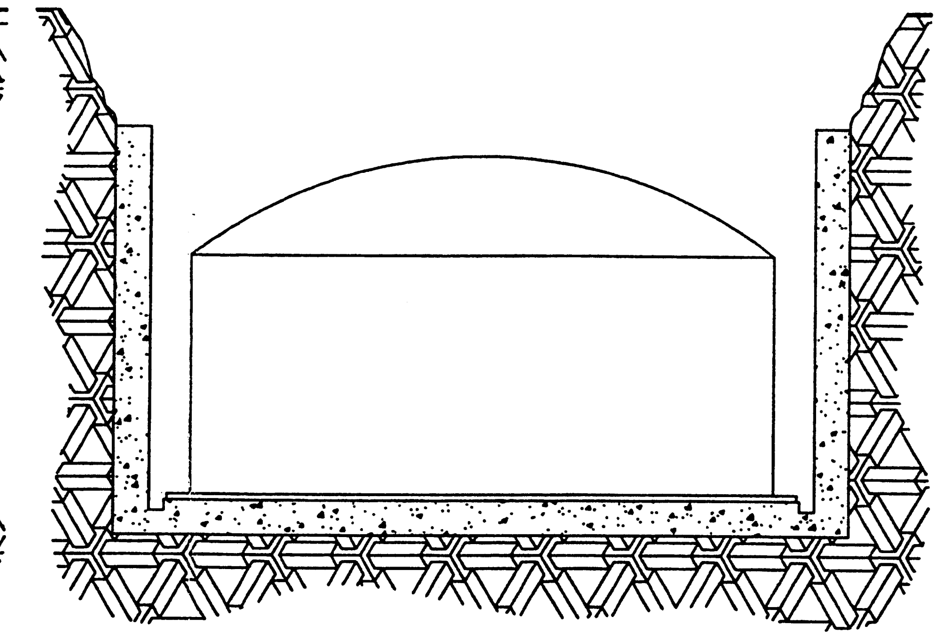


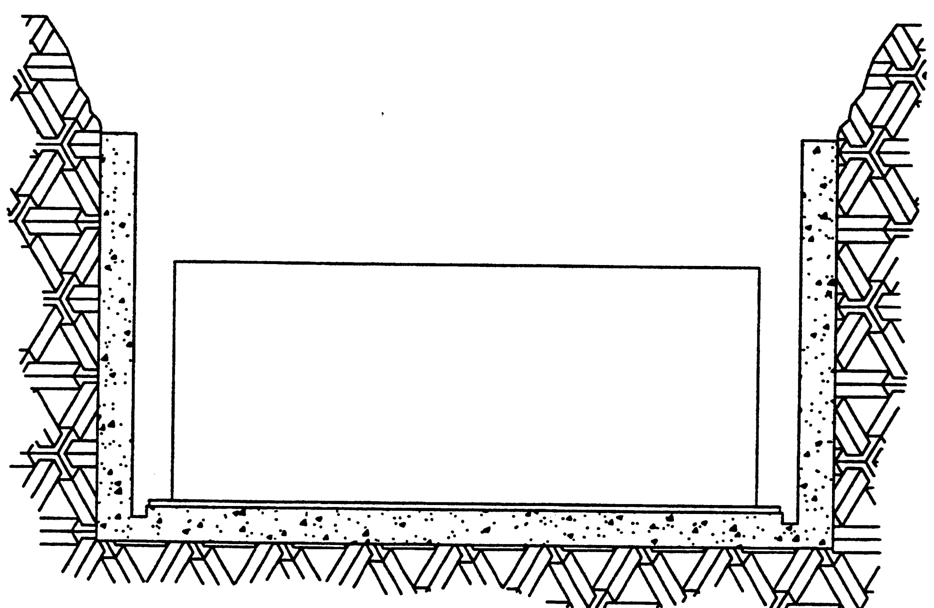
1. INITIAL CONDITION (TYPICAL)



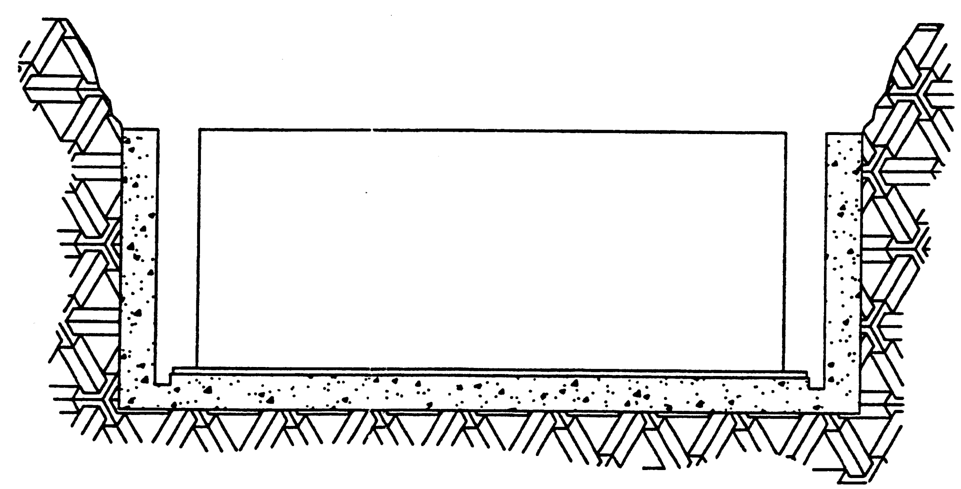
2. EXCAVATE SOIL OVER VAULT AND REMOVE BURIED OBJECTS



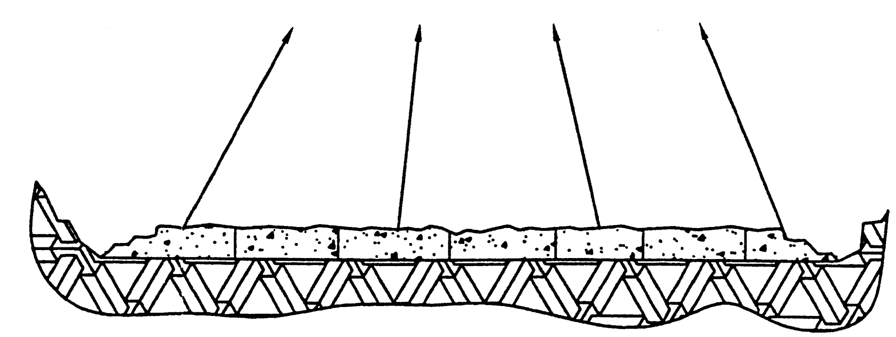
3. CUT OFF RISERS AND REMOVE VAULT ROOF



4. SECTION AND REMOVE TANK



5. REMOVE UPPERMOST VAULT PANEL



6. ENLARGE SOIL EXCAVATION AND REMOVE VAULT FLOOR

NOTE:

1. FIGURES SHOW PLAN FOR VES-WM-182 THROUGH -186. VAULTS WITHOUT PANELS WILL REQUIRE DEMOLITION BEFORE REMOVAL.
2. EXCAVATION OF THE TANKS AND VAULTS WILL BE DONE REMOTELY.
3. REPEAT STEPS 4 AND 5 AS NECESSARY.
4. THIS EXCAVATION PIT WILL BE BACKFILLED AFTER REMOVING ALL 11 TANKS AND VAULTS. BACKFILLING WILL BE DONE BY THE RCRA AND CERCLA PROGRAMS.

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: EE THOMAS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
TOTAL REMOVAL CLEAN CLOSURE
TANK AND VAULT DEMOLITION

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA, TYPE, CL, OBJECT 530 | DWG- | REV
SCALE: NONE | SHEET 1 OF 1

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7.1.7 Waste Disposal

7.1.7.1 Waste Classification. Throughout the D&D process, the waste being removed from the excavation pit will be disposed of rather than stored for long periods of time. Table 7-1 summarizes the equipment expected to be removed during the RCRA Clean Closure by Total Removal of the TFF. The assumed waste classification for each piece of equipment is based on information contained in Reference 7-13 as well as engineering judgement.

Once the waste has been classified, a final disposal site must be determined for the waste and the required packaging identified. This information is given in Table 7-2.

7.1.7.2 Loading Facility. A loading facility would be required to load the waste into the packages. See Reference 7-1: LMITCO Planing Cost Estimate, "WAG 3 FS Cost Estimates, Group 1 Tank Farm Soils – Alternative 3," Estimate File No. 2951, 6-23-97, for more information on this loading facility. It is assumed that due to the similar waste packages involved in RCRA TRCC, the same loading facility would be used. Modifications to the facility would be necessary to accommodate the new shipping casks required for sending mixed and radioactive waste to the DTF.

7.1.7.3 Debris Treatment Facility. RCRA requires proper management of RCRA waste. A debris treatment facility (containment building) is one of the most efficient ways to properly manage the large volumes of mixed debris wastes that will result from the clean closure of the TFF per RCRA land disposal restrictions (LDRs). This is due to the numerous waste codes and the potential inability to use conventional methods of treatment for LDR compliance. A DTF does not currently exist for any significant volume of mixed debris wastes such as will result from the clean closure of the TFF; thus a new DTF to treat mixed waste to RCRA LDRs will have to be built before starting TRCC activities. A RCRA permit will be required for the facility unless the building was operated as a 90-day storage and treatment unit.

Once the waste had undergone debris cleaning, it could be managed as radioactive waste. The radioactive waste will be sent to an LLW Disposal Site that will also meet RCRA Subtitle D requirements.

7.1.7.4 Low Level Waste Disposal Site. Because of the high volumes of waste expected from the total removal of the TFF, it should be assumed that a new LLW Disposal site that also meets RCRA Subtitle D landfill requirements will be built for the TFF waste. It is further assumed that this LLW disposal site will be located on the INEEL site.

7.1.8 Postexcavation Activities

7.1.8.1 Characterization and Sampling. Once all of the tanks, vaults, pipes, concrete encasements, etc. have been removed from the TFF, final characterization would be performed on the site to verify that the site has been sufficiently cleaned for TRCC. The characterization method employed would be the same as that used in Section 7.1.2 for initial characterization. Final sampling using conventional methods would be used to verify closure.

7.1.8.2 Backfill Excavation Site. CERCLA would first backfill the excavation site to the level possible using the soil that had been stockpiled within the Area of Contamination. RCRA would then backfill the excavation site, bringing the site back to grade level. At this point, the site would be "clean" and would fall out of both RCRA and CERCLA management.

Table 7-2. Final disposal site and required packaging.

Waste Classification	Disposal Plan	Required Packaging
Mixed waste – remote and contact handled	Waste will be shipped to a Debris Treatment Facility (not currently in existence) for treatment to RCRA land disposal restriction treatment standards. [a]	A large volume, large weight payload capable, "moderately" shielded transport cask will be required. Assuming the Debris Treatment Facility (DTF) is located at the INEEL, an INEEL-onsite-use-only transport cask, that is operated under locally authored and approved safety documentation, will suffice. At present, the INEEL only possesses one cask of this type – the 14-190 (220 ft^3 internal capacity, 23,000-lb payload, and 7 inches of concrete for shielding). Assuming the DTF is located off the INEEL, a DOT authorized transport cask will be required.[c]
Radioactive waste – remote or contact handled	After the waste has been debris cleaned, it will be classified as low-level radioactive waste (LLW) and will be shipped to a RCRA Subtitle D LLW Disposal Site. [d]	Same candidates as for mixed waste.[e]
Uncontaminated solid waste	INEEL Landfill Complex as industrial waste, noncompactible, nonconditional waste.[f]	DOT 7A Type A D&D Bin.[g]

a. For the purposes of this study, it is assumed that the Debris Treatment Facility is located on the Idaho National Engineering and Environmental Laboratory site. It is also assumed that the Debris Treatment Facility will remove the hazardous constituent from the mixed waste and that just LLW radioactive waste will be left.

b. The safety analysis will have to demonstrate that the presence of the hazardous constituents will not adversely affect the transport cask's containment capability (i. e. ,the presence of VOCs or any other off-gas will not degrade the cask's containment seals). Assume there will be a commercially available cask that is NRC licensed and meets Type B containment when the waste is shipped.

c. The DOT authorized transport casks will be those that are certified by the NRC to its Type-B requirements (10 CFR 71 requirements). Currently there are four commercially available casks of sufficient volume and weight payload capacity to be considered viable candidates, though none of these four are as big as the 14-190. The number of copies of each is unknown. There are a significant number of like-sized, commercially available casks – the NRC-certified LSA/Type-B casks. However, after April 1999, they will be severely restricted in contents such that they will not be viable candidates. It is reasonable to expect that commercial vendors will upgrade their "fleets" to replace a portion of these LSA/Type-B casks, thus increasing the number of suitable candidates.

d. Because of the high volume of waste expected from the total removal of the TFF, it should be assumed that a new LLW disposal site will be built for the TFF waste. It is further assumed that this LLW disposal site will be located on the Idaho National Engineering and Environmental Laboratory site.

e. Assume treatment does not reduce volume. Disposal using these casks will require the use of a disposable liner. A disposable transport package that may be suitable is the INEEL's DOT 7A Type-A Mark III Concrete Box – a 4-by-4-by-8-foot concrete shielded box with a 12,000-lb payload capacity.

f. A size limit is not given for concrete – "must be transported in equipment that is designed and constructed to be readily emptied and is kept clean" - (DOE/ID-10381, Rev. 6, February 14, 1997, Section 4.3.1).

g. A DOT 7A Type A D&D Bin is 78 inches wide by 48 inches high by 114 inches long,; weight capacity of 10,000 lb per bin.

7.1.8.2.1 Estimated Exposure during Total Removal Activities—Preliminary exposure calculations, based on ICF Kaiser Engineering's methodology for estimating exposure, indicate that the expected total personnel exposure for TRCC activities at the TFF will be 9,433 Rem. This estimate assumes that the tanks and vaults will be removed remotely. See Reference 7-14 for more information on the expected personnel exposure during total removal D&D activities.

7.2 Risk-Based Clean Closure

Using risk assessments to support "clean closure" is based on the 1996 policy by EPA[7-15] that allows using fate and transport models to support RCRA clean closure demonstrations (EPA 1996). A risk assessment evaluates the impacts to human and ecological health that could result from exposure to any residues or contaminants that remain in the regulated unit. For consistency, EPA's CERCLA risk assessment methodologies will be used to develop the RCRA risk assessment criteria.

The risk assessment analyzes the baseline risks and identifies the degree of hazard or threat that exists. Based on the risk assessment, the need for action is identified and the degree of short- and long-term closure method effectiveness is established. For example, the risk assessment may identify that system decontamination is successful and risks to human health and the environment are acceptable.[a] In this scenario, the unit would be "clean closed." If the risk assessment identifies potential "unacceptable" risks, the unit would receive additional decontamination or be closed as a landfill so as to protect human health and the environment over the long term. The main TFF RBCC steps are:

1. Tank Isolation (Section 7.2.1)

2. Heel Stabilization (Section 7.2.2)

3. Vault Void Management (Section 7.2.3).

Upon completing these steps, RCRA RBCC would be satisfied and the RCRA closure certification would be accomplished.

A transfer of regulatory authority to the CERCLA program would occur upon RCRA Closure completion. CERCLA would then take responsibility for long-term monitoring and capping of the TFF. Following RCRA closure completion, the tank void would be available for use as an LLW near-surface landfill where the LLW waste meets the NRC Class C requirements, or for disposal of CERCLA wastes (Section 7.2.4). The tank voids could also be filled with clean (nonradioactive, uncontaminated) grout, or other fill material (i.e., sand and gravel).

The following subsections provide additional information on these steps relative to RBCC. To avoid duplication, references to sections where the identified steps are described in more detail have been provided.

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[a] Acceptable as defined by the Closure Plan's predetermined standard. This standard is anticipated to be between the range of 10^{-4} to 10^{-6}.

7.2.1 Tank Isolation

Tank and pipe isolation sequencing in support of RBCC requires coordination between cease use and closure activities. Sequencing coordination is required to allow individual tank pipe and valve box isolation, system decontamination, while maintaining waste processing capability until the last tank has reached a cease use condition. While the sequencing schedule is beyond the scope of this analysis, the sequencing method is identified in Section 8.1. Tank Isolation Method 1 (see Section 8.1.5) is the recommended isolation method for tank and pipe isolation associated with RBCC as excavation is not required to gain access to the piping. This isolation method has lower labor and equipment costs, lower personnel radiation exposure, and reduced waste generation.

7.2.2 Heel Stabilization

Heel stabilization was defined in Section 2 as "the process which includes washing, flushing, pumping, pH adjustment, heel displacement, and free liquid elimination." Heel stabilization is expected to occur in the same manner as defined in Section 8.2. The one exception is the number of tank washings, flushings, and heel characterizations. More effort is expected to meet the RBCC criteria. It is assumed that additional tank wall washings and heel flushings will provide the risk reduction required. The actual number of washing, flushing, and characterization iterations is not known at this time. Washing and flushings would continue to a predetermined number and a final heel contaminant characterization would occur. This final characterization information would be used to verify compliance to the risk assessment criteria. The tank could be closed as a landfill if the risk acceptance criterion has not met by the final washing, flushing, and characterization step.

7.2.2.1 Heel Contaminant Characterization. The tank heels would be characterized as part of heel stabilization. This characterization would provide information on the chemical, radiological, and physical data of the heel. This information would be used to update the risk assessment, decontamination techniques, and management requirements for any newly generated waste.

Additional heel characterizations are expected to establish the rate of mixed waste reduction. These additional characterizations will provide trending information and allow system adjustments to ensure the highest possible waste reduction rate and remedial assessment (RA)compliance.

7.2.2.2 Risk Assessment Achievement. The TFF contaminant characterization identifies whether the risk assessment's performance standard for protecting human health and the environment has been achieved. If the risk assessment criterion has been achieved, no additional decontamination is required. If the risk assessment criterion has not been achieved, additional decontamination would be required or CLFS could occur if RBCC is not achievable.

7.2.2.3 Iterative Tank Decontamination. An iterative series of decontamination will be conducted on the tanks. Tank washdown equipment will be installed to remove contaminants from the tank dome, walls, and floor. These areas will be washed down to remove contamination using a cleaning solution applied by a high-pressure decontamination system. Following the removal of as many contaminants in the tank bottom as possible using existing equipment, the heel would be flushed, agitated and removed using a submersible pump so that less than a 1-inch heel remains. At this time, the heel would be characterized to determine if it meets the performance standard for decontamination removal. An interative series of this decontamination and verification process would be conducted until the performance standard for contaminant removal has been met.

7.2.2.4 Heel Grouting. Following the iterative tank decontamination series. liquid heel remnants would still exist at the bottom of each tank. Because of the remnants liquid nature, a clean (noncontaminated) grout would be added to the tank to eliminate the free liquids. This would occur as discussed in Section 8.2.4.

7.2.3 Vault Void Management

Vault void management for RBCC is similar to CLFS (see Section 8.3). The vault would be accessed via several risers, tank leak monitoring lances would be installed, and the vault would be grouted. Section 8.3 discusses these items in more detail. RBCC requires the following additional steps.

Vault access and preparation would occur in the same manner as discussed in Section 8.3.

7.2.3.1 Iterative Vault Decontamination. A higher level of cleanliness is expected inside the vaults for RBCC than CLFS. This will require additional work before vault grouting can occur. The vault sumps collect leakage from piping, tanks, or groundwater and jet the contents back to the tanks. The sumps and associated collection system, if contaminated, would undergo a series of spray washes to remove contaminants from the vault system to acceptable levels. Following this decontamination method, sampling would be conducted to verify the success in meeting the contamination removal performance standard. An iterative decontamination and verification process would be conducted until the performance standard for contamination removal has been met.

7.2.3.2 Vault Grouting. Liquid remnants would exist at the bottom of each vault following the iterative vault decontamination series. Because of the liquid nature of these remnants, a clean grout would be added to the vault to eliminate the free liquids. The vault would then be filled with grout to eliminate the subsidence or collapse potential of the vault and prevent liquids (e.g., runoff) from entering the vault void (see Section 8.3). This step would complete the tank activities associated with the RCRA closure process and the tank voids would then be available for use by other programs.

7.2.4 Tank Void Management

Tank void management would occur in the same manner as described in Section 8.4.

7.2.5 Conclusions

RBCC is possible based on the analysis done to date. Further work must be done to establish the actual closure sequence, materials, and equipment used to accomplish the closure process. The closure and tank void filling processes should be tested on a mocked up tank system to verify proof of principle before actually being used.

Tank isolation and heel stabilization operations must be coordinated to establish the actual isolation sequence of each line. Certain lines are required for use during heel stabilization efforts. Tank isolation and heel stabilization operations must occur soon after (within 2 years) cease use to facilitate closure by 2035. The actual cease use and closure sequence and timing must be defined with the 2035-completion date in mind.

Regulatory issues associated using the TFF for an NRC landfill for NRC Class C type waste must be addressed and resolved before Class C waste placement is possible.

7.3 REFERENCES

7-1 LMITCO Planning Cost Estimate, "WAG 3 FS Cost Estimates, Group I Tank Farm Soils-Alternative 3," Estimate File No. 2951, 6-23-97.

7-2 EDF-TFC-006, D. Machovec Interview - Clean Closure of Tank Farm, M. M. Dahlmeir

7-3 EDF-TFC-014, Characterization Costs, M. M. Dahlmeir

7-4 Buried Waste Integrated Demonstration Human Engineered Control Station Final Report, by the Human Engineered Control Station Team, EGG-WTD-11446, September 1995.

7-5 EDF-TFC-021, Recommended Instrumentation During Retrieval Operations, M. M. Dahlmeir

7-6 "High Level Waste Tank Farm Replacement Project-Existing Tank Heel Removal Special Study," Westinghouse Idaho Nuclear Company, Inc., RPT-025, April 1993, ICF Kaiser Engineers.

7-7 "Tank Farm Heel Removal Project-Conceptual Design Report," PT-034 Lockheed Idaho Technologies Company, Feb 3, 1995.

7-8 "High Level Waste Tank Farm Replacement Project-Existing Tank Flushing Special Study," Westinghouse Idaho Nuclear Company, Inc., RPT-030, August 1993, ICF Kaiser Engineers.

7-9 "High Level Waste Tank Farm Replacement Project - Heel Removal Schedule and Risk Assessment," Westinghouse Idaho Nuclear Company, Inc., RPT-031, December 1993, ICF Kaiser Engineers.

7-10 EDF-TFC-023, Recommended Heavy Equipment and Sizing Equipment for Total Removal Activities, S. P. Swanson

7-11 Hot Spot Removal System: System Description, September, 1997, INEEL/EXT-97-00666.

7-12 EDF-TFC-016, Take-Off Calculations for the Total Removal of Soils and Structures at the Tank Farm Facility, S. P. Swanson

7-13 EDF-TFC-015, Packaging and Disposal Options for the Waste Resulting from the Total Removal of the ICPP Tank Farm, M. M. Dahlmeir

7-14 EDF-TFC-020, Exposure Calculations for Total Removal Clean Closure, S. P. Swanson

7-15 EPA 1996 Memorandum from Herman, S. A. and E. P. Laws to RCRA/CERCLA National Policy Managers Regions I-X "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities, August 14, 1996.

8. CLOSURE TO RCRA LANDFILL STANDARDS

The closure methods discussed in this section are directly applicable to Options 4 through 6. See Section 2 for a description of the options.

The TFF contains 11 interim status RCRA units regulated as tank systems (40 CFR 265 Subpart J), therefore, RCRA closure requirements are invoked (see Sections 4.3.1 and 4.3.2). RCRA closure regulations for tanks require removal or decontamination of all waste residues, contaminated system components, contaminated soils, and structures and equipment contaminated with waste ("Clean Closure" as identified in Section 7). If it is demonstrated that removal or decontamination is impractical, then the system must be closed, and postclosure care performed, in accordance with the closure and postclosure requirements that apply to landfills. This section identifies methods for closing the TFF to RCRA landfill standards. Requirements for RCRA closure to landfill standards are in Section 5.

TFF Closure to RCRA standards is expected upon completion of the following tasks:

1. Tank isolation (Section 8.1)

2. Heel stabilization (Section 8.2)

3. Vault void grouting (Section 8.3).

A transfer of regulatory authority to the CERCLA program would occur upon RCRA Closure completion. CERCLA would then take responsibility for long-term monitoring and capping of the TFF. Following RCRA closure completion, the tank void would be available for use as an LLW near-surface landfill where the LLW waste meets the NRC Class C requirements, or for disposal of CERCLA wastes (see Section 8.4, Tank Void Management). The tank voids could also be filled with clean (nonradioactive, uncontaminated) grout, or other fill material (i.e., sand and gravel).

The following subsections describe how the TFF can be closed to RCRA landfill standards:

Section 8.1 discusses tank isolation. Items discussed in this section include:

1. Cease use sequencing

2. RCRA Closure sequencing

3. Isolating individual tanks from the rest of the TFF.

Isolation requires cutting, grouting (when applicable), and capping all ancillary piping associated with the isolated tank. Ancillary piping classifications (process lines, instrumentation lines, air/steam and lines, etc.) are also discussed.

Section 8.2 discusses heel stabilization. Possible heel stabilization methods are developed and presented here. The main heel stabilization tasks are tank preparation and heel displacement.

Tank preparation includes:

1. Removing tank liquids using existing waste transfer equipment (This is the point where cease use is verified)

2. Installing a temporary VOG system

3. Removing existing tank riser equipment

4. Installing video and lighting equipment

5. Characterizing the heel

6. Washing the inside tank walls

7. Installing mixing and submersible pumps

8. Adjusting the heel pH.

Heel displacement includes:

1. Displacing the heel using grout

2. Absorbing the remaining free liquids using dry grout

3. Installing a heel cover using grout.

Grout composition and characteristics are also discussed.

Section 8.3 discusses vault void management. Vault void management tasks include:

1. Accessing the vault voids

2. Decontaminating the vault voids, as applicable

3. Providing tank monitoring capability

4. Filling the vault voids with grout.

Filling the vault void with grout defines the point of RCRA closure, prevents short-term subsidence, and minimizes water infiltration.

Section 8.4 discusses tank void management. Tank void management tasks include:

1. Accessing the tank voids

2. Filling the tank voids with LLW (NRC Class C)

3. Filling the tank voids with clean grout

4. Filling the tank voids with CERCLA waste.

Filling the tank void prevents long-term subsidence. Depending on the fill material used, tank void filling would occur during or after vault void filling.

8.1 Tank Isolation

Cease use must occur as required by the Consent Order (see Section 1), which then invokes RCRA closure. The sequence for cease use and closure must be developed and coordinated with ongoing liquid waste processing efforts. Tank isolation activities occur after cease use and start the RCRA closure process.

8.1.1 Tank Cease Use Sequence

Coordinating cease use and closure activities with ongoing waste processing operations will require detailed planning to overcome issues with system piping isolation. This planning must develop the tank cease use and RCRA closure sequence that allows tank pipe and valve box isolation while maintaining waste processing capability until the last tank has reached a cease use condition. This section identifies the cease use sequence used for this study, which then sets the bases for the closure sequence. Two cease use schedules were developed and presented.[8-1] The cease use shown in Table 8-1 is the "optimized case," as this schedule was shown to meet the Settlement Agreement requirements. Table 8-1 illustrates the proposed cease use sequence.

8.1.2 Tank Closure Sequence

The TFF tank closure sequence depends upon the actual cease use sequence and physical location restrictions. Any change to the cease use sequence may affect the closure sequence. It is assumed that tank isolation will occur within 2 years after cease use. Certain tank isolation and heel stabilization tasks are expected to overlap since some tank lines must be used during heel stabilization.

Table 8-1. Estimated cease use sequence order.

Cease Use Order	Tank Identification Number	Cease Use Date
1st	WM-185	Sept. 1999
2nd	WM-180	Mar. 2001
3rd	WM-181	Sept. 2001
4th	WM-184	Sept. 2001
5th	WM-183	Mar. 2002
6th	WM-182	Sept. 2002
7th	WM-186	Mar. 2009
8th	WM-189[a]	Sept. 2010
9th	WM-187[a]	Mar. 2011
10th	WM-188[a]	Sept. 2011
11th	WM-190[a]	Sept. 2011

a. Tank could be used to store heels removed from other tanks during closure activities. Currently WM-189 is estimated to be the tank used. The tank heels from the remaining tanks would be sent directly to the appropriate processing facility.

The estimated closure sequence is identified in Figure 8-1. Certain tanks must be closed at the same time. WM-182 and WM-183 have two, 3-inch stainless steel overflow lines that connect the two tanks together. Tanks WM-187 through WM-190 share common process lines, and should be closed as indicated by Figure 8-1. All other tanks may be closed separately depending on the overall closure needs. The actual closure sequence must be developed and is beyond the scope of this study.

8.1.3 TFF Piping Description

TFF mixed waste transfer piping is buried at a depth of 12 to 21 feet belowgrade. The waste transfer piping is constructed of stainless steel with a stainless steel encasement, which provides secondary containment in the event of a waste transfer line leak. Encasements are routed to valve boxes designed to allow leak detection of any waste line. Three types of encasements were used:

1. Split tile (removed or taken out of service)

2. Stainless steel-lined concrete

3. Stainless steel pipe.

Valves are housed in concrete stainless steel-lined boxes (valve boxes). Some valve boxes have stainless steel decontamination lines that could be used for decontamination flushing of waste transfer piping. Wastes collected in the valve box sumps are jetted to tank WL-133 or drained to valve box C-12. Wastes collected in valve box C-12 are jetted to WL-133. Buried concrete junction boxes are located where piping runs change direction.

A cathodic protection system is used to protect buried waste lines from external corrosion. A plan to maintain this protection must be developed, but is beyond the scope of this study.

TFF steam and air piping along with instrumentation and electrical conduits will be assumed free from internal contamination since process waste has not been transferred through these lines. Waste transfer lines are contaminated with mixed waste; therefore, a decontamination method must be developed to clean these lines. For this reason, waste transfer lines will be handled differently from all other lines.

8.1.4 Tank WM-183 Piping

The TFF tank systems were constructed based on three main designs. Each tank system design has unique piping issues. Defining each tank and its associated piping system for closure was beyond the scope of this study. A single tank system was selected that would bound the issues associated with viable tank isolation scenario development. Tank WM-183 was selected based on key personnel interviews and engineering judgement.

WM-183 tank has:

- Cooling coils, (common to all tanks except WM-181,WM-184, and WM-186)

Estimated TFF Closure Sequence Flow Diagram

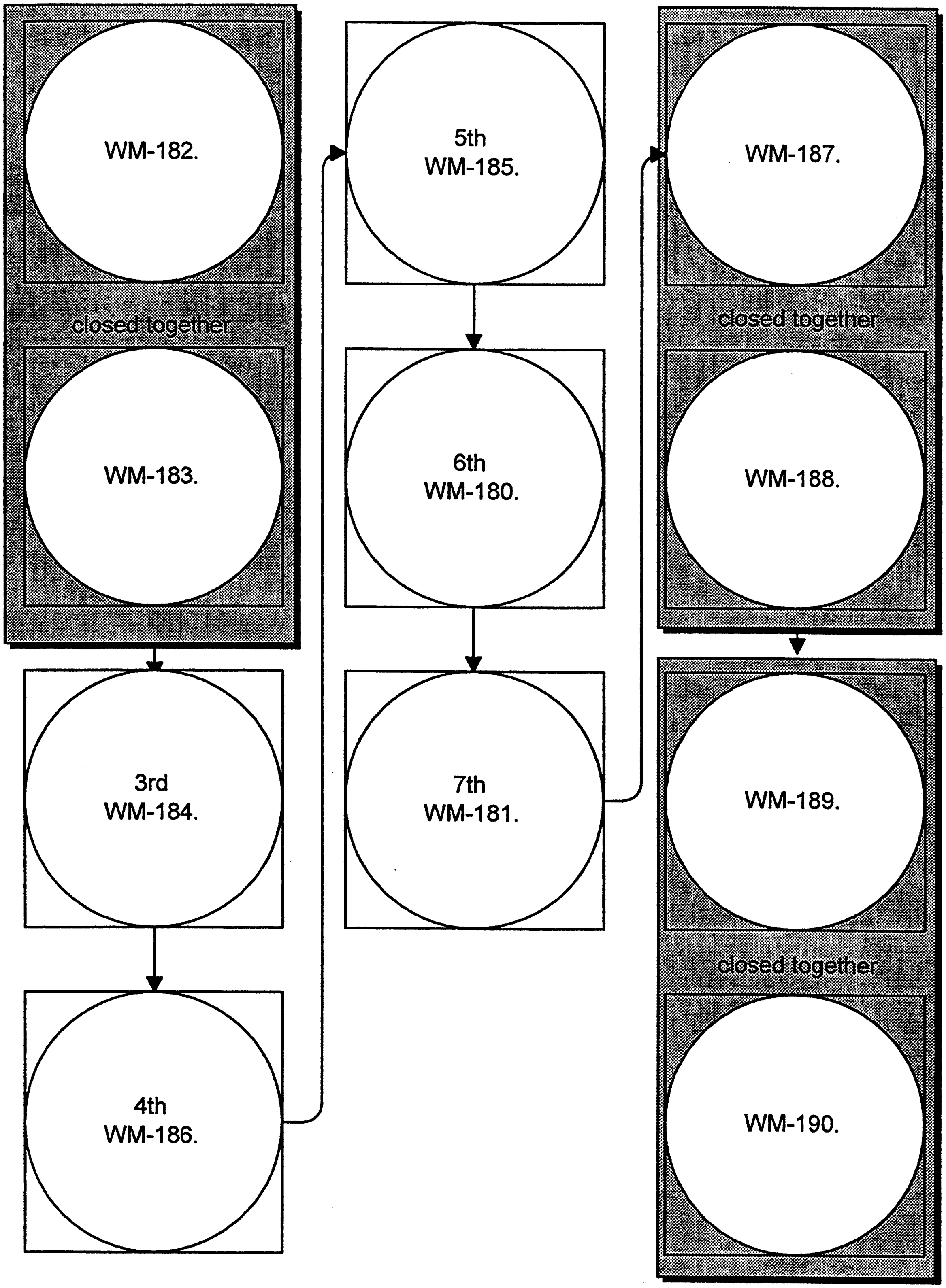


Figure 8-1. Estimated TFF Closure sequence flow diagram.

NOTE: Potassium dichromate and sodium hydroxide are added to the demineralized water to inhibit corrosion in the stainless steel cooling coils. The cooling water solution will be treated as hazardous waste once no longer needed due to the chromate.

- Separate VOG moisture condenser
- Four 12-in. diameter risers
- Two overflow lines from Tank WM-182 to WM-183 21 feet belowgrade (unique to these two tanks)
- Two lines coming from the tank that connect to a single pressure relief valve (other tanks have a single line going to a single pressure relief valve)
- Encasement transfer line that drains into a vault sump.
- Three future pipe stub connections on the waste transfer line (Unique to WM-183).

NOTE: The pipe stubs may require excavation (21 feet belowgrade) for closure since flushing the pipe connected to these stubs may not clean the stubs themselves. Additional evaluation will be required during the design phase to establish the actual cleaning method for these stubs or if the stubs could be abandoned in place.

8.1.5 Tank Isolation Method Identification

Tank isolation issues associated with WM-183 were analyzed and various methods were developed. The following methods were identified:

1. Flush waste process lines to decontaminate, then purge using compressed air. Cut and grout the waste transfer piping lines from inside one valve box to another connecting valve box. Lines other than waste transfer piping that slope away from the tank will be cut and capped in associated buildings. Lines sloping toward the tank will be cut, grouted, and capped, with the exception of ¼-inch instrumentation lines. One-quarter in. instrumentation lines will be cut and capped regardless of slope. It will be necessary to grout valve boxes to prevent water collection in the valve box sumps.

   NOTE: Tank isolation requires more effort than allotted for this study. Additional isolation requirements must be developed for each tank and should be done as part of the design phase for each tank closure.

2. Flush waste process lines to decontaminate and purge using compressed air. The waste transfer piping, steam, air, water, and instrumentation lines will all be excavated, removed, and disposed of properly. Valve boxes will still require grouting.

3. Flush waste process lines to decontaminate and purge using compressed air. Remove only the mixed waste contaminated transfer lines (those that cannot be determined clean) and dispose of that piping according to the proper waste category. This will require excavating and cutting piping into lengths that can be disposed of properly. All other piping, conduit, and instrumentation lines will be cut, capped, grouted (as necessary), and left in place. Valve boxes will still require grouting.

4. A boundary will be established at the tank vault walls. This boundary will establish the location to excavate down to the piping, instrumentation, etc. The waste transfer lines will still require decontamination flushing and purging with compressed air. The piping lines will be left in place and prepared for cutting, grouting (as necessary), and capping. Valve boxes would still require grouting.

Tank Isolation Method 1 is the recommended isolation method because excavation is not required to gain access to piping. Excavation requires the last few feet be dug by hand to prevent damage to the pipe trench and piping. Excavation would be costly, time consuming, and increase personnel radiation exposure. Prior TTF projects used valve boxes to cut and cap waste transfer lines with success. Using Tank Isolation Method 1 translates into lower labor and equipment costs and personnel radiation exposure, and reduced waste generation.

8.1.5.1 Recommended Tank Isolation Method Steps. The following main steps outline the recommended tank isolation method for piping associated with a TFF waste storage tank. These steps are not intended to be all-inclusive.

1. Verify existence and location of all piping lines, including abandoned lines, associated with the tank being isolated using existing TFF drawings and key personnel knowledgeable with the TFF.

2. Develop a tank isolation-sequencing plan so that they do not interfere with ongoing efforts to calcine the remaining liquid waste stored in the other tanks.

3. Develop a tank piping isolation plan that would include the following:

NOTE: When possible, separate operational lines from lines being isolated using existing valving. Use approved tag and lockout procedures. Use double valve protection when possible. Line separation will be verified using an approved valve configuration check-off list.

NOTE: Plan must leave certain existing lines active until heel stabilization efforts no longer require that piping. The actual lines left active and the isolation sequence for these lines must still be developed and is beyond the scope of work for this study.

a. Cut and cap all nonwaste transfer lines that slope away from the tank.

b. Cut, grout, and cap all nonwaste transfer lines that slope toward the tank.

c. Perform proper valve lineup to allow waste transfer line flushing into a preselected waste storage tank. Use approved valve configuration procedure.

d. Flush all waste transfer lines with appropriate decontamination fluid(s) and number of flushes.

e. Purge flushed waste transfer line(s) for 10 minutes, minimum, using compressed air to ensure decontamination fluid is pushed into the waste storage tank. Monitor tank pressure to prevent overpressurization.

f. Let piping set for 15 minutes to allow any remaining liquids to drain or pool.

g. Purge flushed waste transfer line(s) again for 10 minutes, minimum, using compressed air.

h. Cut flushed and purged waste transfer line(s) from inside a valve box.

i. Cut the other end of the flushed and purged waste transfer line(s) from inside another connecting valve box to isolate that section of pipe.

j. Grout and cap the isolated waste transfer line(s).

k. Grout and cap remaining flushed and purged waste transfer line(s) connected directly to the tank.

NOTE: These pipe ends would define the tank isolation zone for each tank.

l. Drain, flush, and purge the tank cooling coils.

NOTE: The cooling water removed from tank coils could be processed through the PEWE.

1. Perform approved tank isolation plan steps.

2. Verify compliance with tank isolation plan.

8.2 Heel Stabilization

The second RCRA closure step identified at the beginning of Section 8 is heel stabilization. Heel stabilization, as defined in Section 2.2.1.1.2, Item 2 is "...the process which includes washing, flushing, pumping, pH adjustment, heel displacement, and free liquid elimination." This section addresses heel stabilization tasks associated with RCRA closure. It should be noted that some overlap is expected between tank isolation and heel stabilization efforts. This overlap requires coordination during actual closure efforts.

The 300,000-gallon tanks are flat on the bottom with liquid waste transfer jets (steam or air) located 4 to 12 inches above the tank floor. This jet positioning limits the liquid waste amount that can be removed from the tanks using the existing waste transfer jet equipment. Waste that cannot be removed using existing equipment is called the heel. Part of heel stabilization is to develop a viable strategy to either remove or solidify the remaining heel. This strategy must be developed as part of an overall TFF Closure Plan and is discussed in this section.

Heel stabilization methods were developed during a Value Engineering (VE) session[8-2] held in July 1997. The VE Session results were used to help develop this section. Scenarios for solidifying the heel with grout are presented along with steps required to prepare the tanks for heel displacement.

8.2.1 General Information

General information on the TFF heels is provided below.

Refer to Section 3 for a tank description.

8.2.1.1 Background. It is assumed that at the time of RCRA closure, the tank contents will be classified as LLW. Tank contents currently consist of high activity waste (HAW), sodium-bearing waste (SBW), and small quantities of RCRA listed wastes. It is likely that the heel will retain portions of these constituents after the tank contents have been adjusted with SBW and cease use has occurred.

8.2.1.2 Previous Studies. ICF Kaiser Engineering conducted a study that planned for total heel removal from the 300,000-gallon tanks. Kaiser produced a conceptual design report[8-3] describing equipment and procedures that would be used in removing the heels. Although Kaiser's conceptual design focused on complete removal of the heel, there are concepts from their design that have been used in this study. These concepts include a temporary VOG system, tank wash down methods, and heel mixing and removal.

8.2.1.3 Existing Tank Farm Drawings. Many drawings of the 300,000-gallon tanks exist, including construction, as-built, piping and instrumentation drawings (P&IDs), etc. Typical tank ~~and piping~~ sketches will be used for purposes of this study. Detailed drawings of individual tanks will be required for any title design work.

Sketches that are schematic in nature have been generated to show typical layouts for the temporary VOG system, grout delivery system, and tank washdown system. Scenario flow charts and sketches have also been developed to show the fundamentals of each heel stabilization method.

8.2.2 VE Session Heel Stabilization Scenarios

Heel Stabilization scenarios were developed during the VE Session noted above. A group of experts in CPP Tank Farm Operations, Regulatory Issues, Radiological Controls, and Engineering were assembled to collectively use their experience, creative input, and problem-solving capabilities to decide the best solutions for this portion of TFF Closure.

Various scenarios (called options in the VE Session.) were initially brainstormed in regard to heel disposition. The brainstormed scenarios were then analyzed for practicality and eliminated if considered unreasonable. Of the initial scenarios, 10 were chosen for further discussion and evaluation. The VE team members considered safety, cost, regulatory issues, stakeholder perceptions, and design as guidelines in selecting the three most viable scenarios for stabilizing the heel. The scenarios were then ranked with the aid of a "Decision Analysis Matrix." The three highest ranking scenarios were selected for further analysis and are described in detail in Appendix C. The scenario with the highest score was selected as the recommended heel stabilization method and is described below.

8.2.2.1 Clean Tank and Grout Any Remaining Heel—Scenario A. This scenario received the highest overall score of the 10 scenarios analyzed (see Option G in the VE Session report). The process does not attempt to remove all waste from the tank but rather makes an effort to remove most of the radioactive and hazardous waste from the tank dome, walls, cooling coils, and floor. This scenario can be modified to meet the RBCC criteria discussed in Section 7.2.

8.2.2.1.1 Heel Stabilization Sequence—The starting conditions that must be satisfied before heel stabilization can occur:

1. Tank liquid has been removed, to the maximum extent possible, using existing waste transfer equipment (steam jets or airlifts) leaving an approximate heel depth of 4 to 12 inches (5,000 to 15,000 gallons). This is the point of cease use.

2. Tank isolation has occurred to the maximum extent possible. RCRA closure has begun.

3. Temporary VOG system connected and operating.

In sequence, the steps required to accomplish Scenario A are:

a. Characterize remaining heel using new sampling equipment (Provides a closure baseline.)

b. Clean tank interior by washing tank dome, walls, cooling coils, and floor

c. Remove as much tank liquid as possible using existing equipment

NOTE: This step is intended to minimize personnel exposure but could be deleted.

d. Complete tank isolation.

NOTE: This step is only required if some tank lines were not previously isolated.

e. Agitate heel and washdown liquid with mixing pump, remove heel with submersible pump (< 1-inch heel remains)

f. Flush heel with water or aluminum nitrate then agitate and remove heel with submersible pump (< 1-inch heel remains). Perform flush twice.

g. Check remaining heel pH, if heel pH is acceptable (0.5–2.0), continue to next step,

   – if heel is too acidic, continue heel flushing and removal process until proper pH has been achieved

   –

h. Characterize remaining heel

i. Deposit liquid grout in tank, starting at point furthest from submersible pump, displacing heel towards submersible pump (grout slump is maintained to allow heel displacement without grout and heel mixing)

j. Continuously remove displaced heel with submersible pump as liquid grout is deposited in the tank bottom

k. Either raise submersible pump to allow grout to flow underneath while still pumping or abandon pump in place

l. Continue adding wet grout until a 12-inch thick grout layer is on tank floor and allow grout to set up

m. Absorb any remaining liquid using dry grout

n. Place additional liquid grout to cover solidified heel and cooling coils by 4 in.

Refer to Figure 8-2 showing the Scenario A flow chart and Figure 8-3 for a simplified sketch.

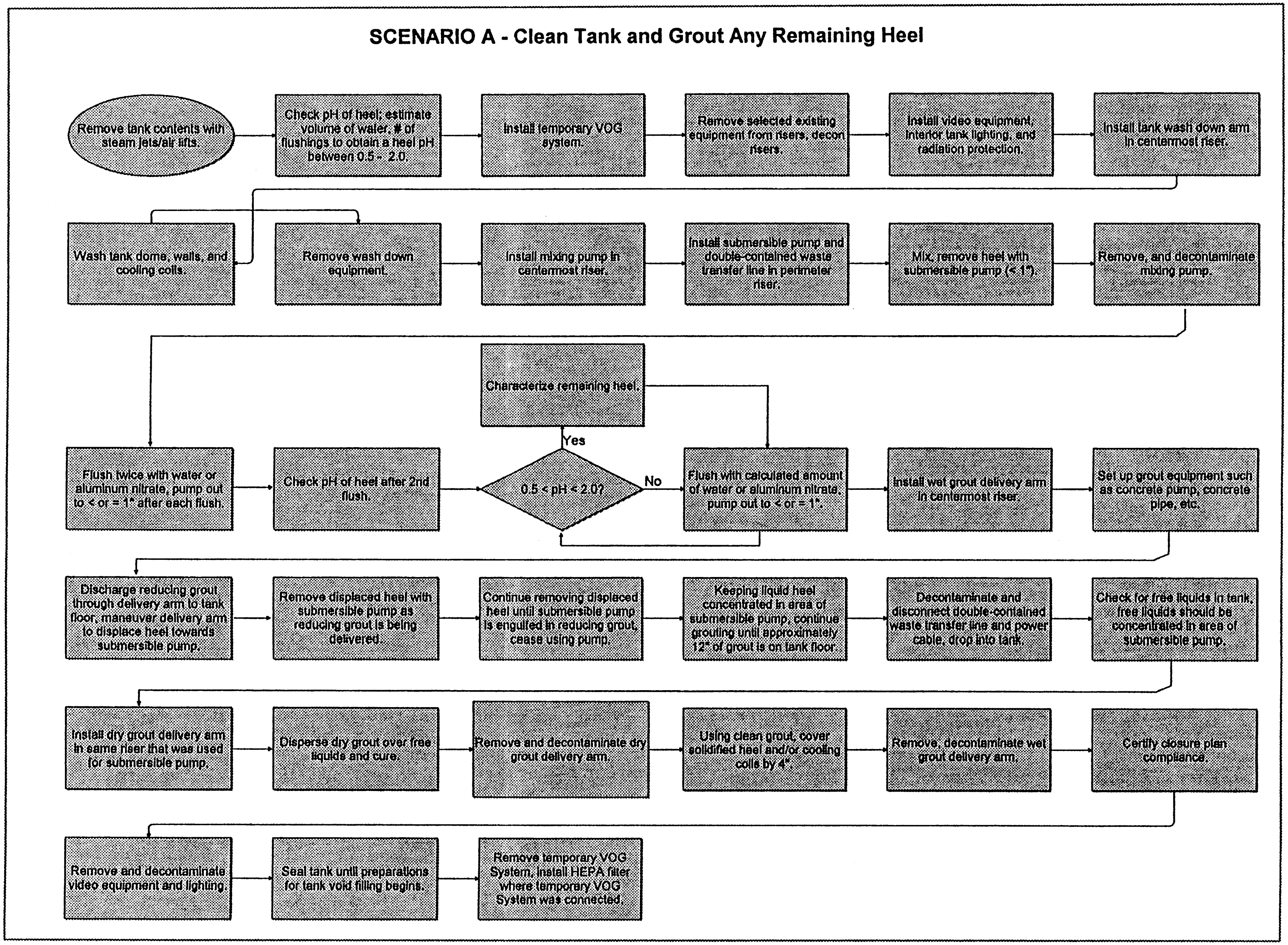
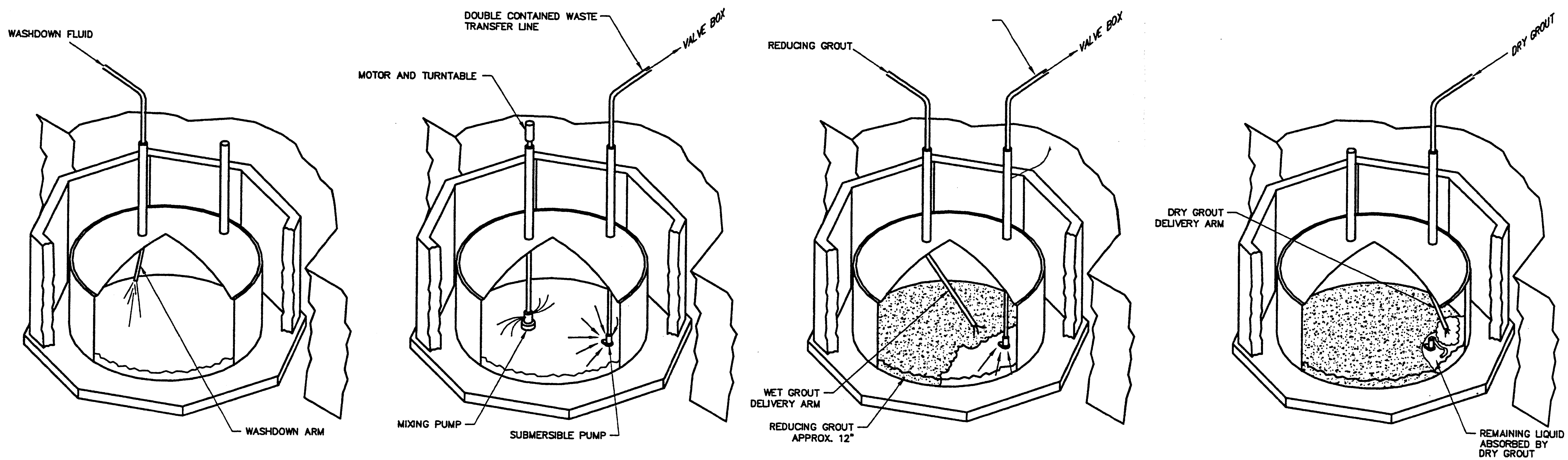


Figure 8-2. Scenario A – Clean tank and grout any remaining heel.

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

SCENARIO A
CLEAN TANK AND GROUT ANY REMAINING HEEL
FIGURE 8-3



1. TANK WASHDOWN

2. HEEL MIXING & REMOVAL

3. HEEL DISPLACEMENT & REMOVAL

4. ABSORPTION OF REMAINING HEEL WITH DRY GROUT

QTY REQD		QUAL LEVEL	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.

PARTS LIST

DASH NO.	NEXT	FINAL	NEXT ASSY
	QTY REQD		

APPLICATION

DIMENSIONING AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS 125✓
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: GREG HOUSLEY
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY

SCENARIO A
CLEAN TANK AND GROUT ANY REMAINING HEEL

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA | TYPE | CL | ORIG 530 | DWG- | REV

SCALE: NONE | SHEET 1 OF 1

File: Figure8-3.dwg
Path: E:\wth\TB-1525
User: WTH
Date: 11/18/97 - 1:08 P.M.

8-13

8.2.3 Tank Preparation

As part of tank preparation various subtasks must be performed before heel displacement takes place. Individual tanks must also be prepared to accept closure equipment.

Tank preparation subtasks include:

1. Removing tank liquids using existing waste transfer equipment (This is the point where cease use is verified.)
2. Installing a temporary VOG system
3. Removing existing tank riser equipment
4. Installing video and lighting equipment
5. Characterizing the heel.
6. Washing the inside tank walls
7. Installing mixing and submersible pumps
8. Adjusting the heel pH.

A description of each tank preparation activity follows.

8.2.3.1 Tank Liquid Removal. Tank contents will initially be emptied as low as possible with existing waste transfer equipment (steam jets or airlifts) to minimize the volume of heel that will be processed for pH adjustment. There are two steam jets per tank, with the exception of WM-189 and WM-190, which have one steam jet and one airlift. Moisture from the steam jets will dilute the liquid jetted out of the tanks by a factor of 5-10%.[8-4]

After the liquid waste has been removed as low as possible with steam jets or airlifts, the remaining liquid heel can be further removed using a submersible pump(s). Further removal of the heel with a submersible pump will depend on the scenario chosen for heel stabilization. Scenario A relies on a submersible pump to remove the maximum heel amount.

It is assumed that liquids removed from the tank undergoing closure activities will be transferred to a "receiver" tank(s) where the liquid will be held for future processing such as evaporation and calcination. The receiver tank(s) could be a tank (currently to be WM-187) scheduled for future heel stabilization or new tank(s) dedicated solely to receiving waste from tanks that are being closed. Future study is required to determine the best method to place and treat waste removed from the tanks undergoing closure.

Receiver tank contents will be periodically reduced in volume at the HLW Evaporator or the PEWE and eventually calcined at the NWCF. Waste routing to the HLW or PEWE will be determined by acidity and radioactivity levels of the liquid. In general, highly acidic and highly radioactive wastes will be processed by the HLW Evaporator.

Liquid evacuation from the tanks will be accomplished by following procedures detailed on a Liquid Transfer Sheet (LTS). LTSs are procedures that specify valve lineups for vessel-to-vessel liquid transfers. If liquid transfers are required that are not covered by an existing LTS, new procedures can be readily developed and implemented after review by Operations, Engineering, Safety, Quality, and Environmental personnel.

8.2.3.2 Tank Washing System. Previous video tank inspections reveal that residues are located on the tank walls and cooling coils. Washing the tank internally is intended to remove or loosen most residue buildup from the walls, flooring, and piping. Removing a large portion of this residue will reduce overall hazardous waste and radionuclides concentrations in the tank.

A previous study[8-5] performed by ICF Kaiser Engineers, "Existing Tank Flushing Special Study," evaluated spray distances, nozzles, and the time and amount of solution required for washing the tank dome, wall, and floor. Three washdown scenarios using different cleaning solutions were also evaluated in the study. The study recommended a solid stream nozzle to initially wash down and remove solids. A fan nozzle was recommended for final rinsing of the tank interior.

Following the study's recommendation, a solid stream nozzle will be used for initial washdown and a fan nozzle will be used for final rinsing. Further study will be required to determine the appropriate cleaning solution used in washing the tank interior.

8.2.3.2.1 Tank Washdown Equipment—The tank washdown system (see Figure 8-4) will use two major pieces of equipment: trailer-mounted washdown skid and a washdown arm. The washdown skid will consist of a decontamination tank, a supply pump, and associated piping and instrumentation. The washdown arm will be inserted within the tank and designed to direct the spray from the top to the bottom of the tank. The washdown arm will rotate 360 degrees so that the entire circumference of the tank can be accessed for washing. Flexible hose will interconnect the washdown skid to the washdown arm.

Tank washdown equipment will be designed for use on all 11 tanks. Adapters for the wash down arm will be necessary to permit use on either 12-in. or 18-inch risers. Freeze protection provisions (i.e., insulation and heat trace) will be necessary for aboveground piping located outside the heated enclosure. A main supply line that is insulated and heat traced may be the most effective means for delivering washdown fluids to the area. The main supply line would have taps strategically located to allow hookup of temporary hoses to wash down equipment at each tank.

8.2.3.2.2 **Tank Washdown Equipment Installation**—Since tank riser locations are different for each tank, tank washdown equipment placement will depend upon the riser location. If the washdown arm is placed in a single location that allows effective washdown coverage of the entire tank, relocation efforts and expenditures within the same tank will be minimized.

Since the concept of Scenario A is to wash most, but not all, residue from the dome, walls, cooling coils, and floor, the washdown arm will initially be placed in the centermost riser. However, if more washdown is desired for particular areas of the tank, the wash down arm could be relocated to another riser. Additional wash downs would be required for Options 1, 2, and 3.

8.2.3.2.3 **Wash Down Procedure**—The dome, walls, cooling coils, and tank floor will be washed down once with approximately 12,000–15,000 gal of water or other cleaning solution.

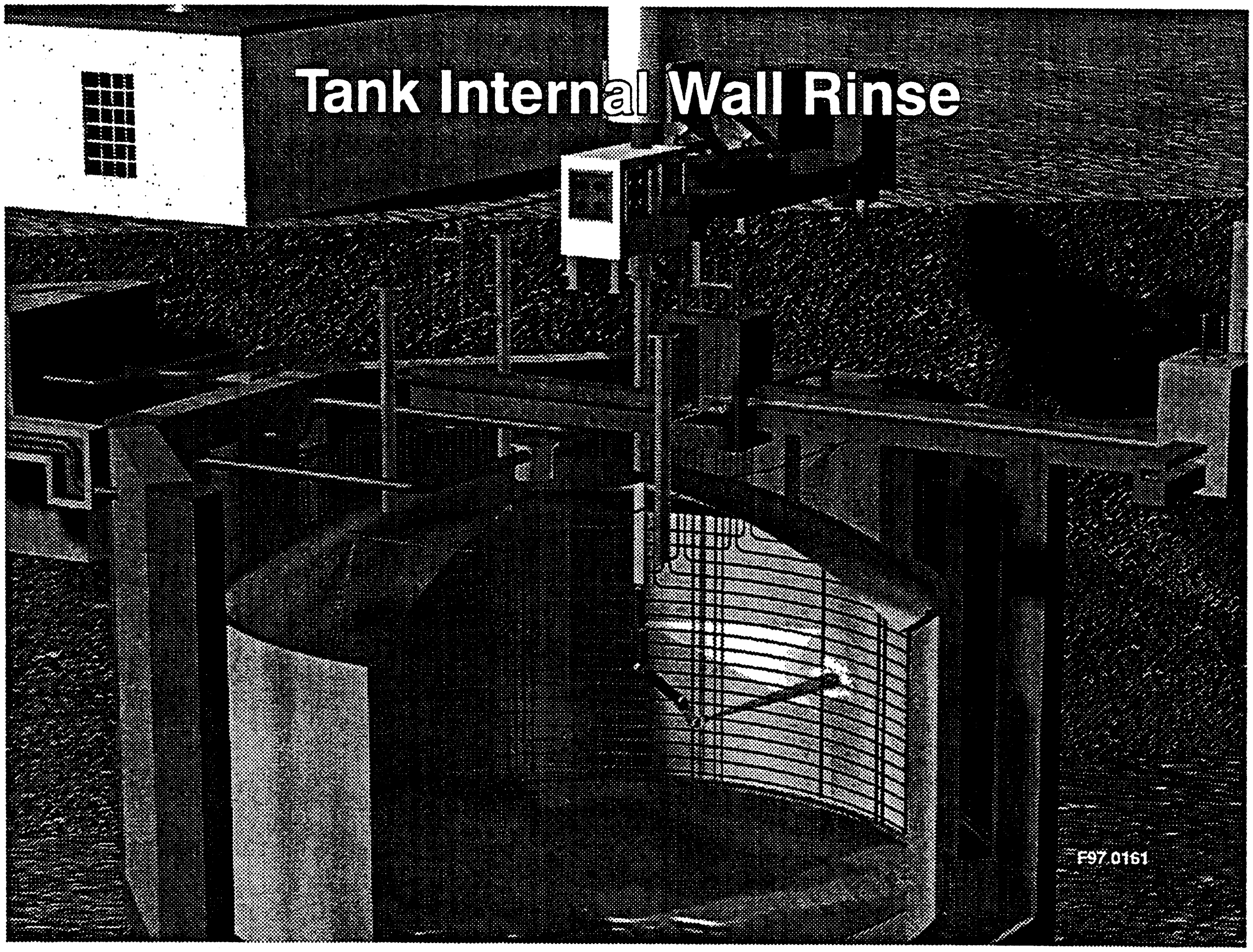


Figure 8-4. Tank internal wall rinse.

Washdown will begin with the cooling coils and tank floor to loosen any sediments that are attached to the piping, crevices, floor bottom, etc. After the floor and coils have been washed, washing will move to the dome area. Upon completion of the dome, the walls will be washed from top to bottom, finishing at the tank floor.

When washdown is complete, the depth of washdown fluid and residues remaining in the tank bottom will be approximately 16–24 inches.

8.2.3.2.4 **Tank Washdown Equipment Removal—**After the tank interior has been washed, the washdown arm will be removed from the centermost riser and reinstalled in another tank. The washdown arm could also be installed in another riser within the same tank for further cleaning.

To minimize contamination of the washdown arm, the outside of the arm could be covered with a removable plastic sleeve. As the arm is slowly withdrawn from the riser, the plastic sleeve would be decontaminated and peeled from the arm. A new plastic sleeve would replace the sleeve that was peeled from the arm in preparation for transport and use in another tank.

8.2.3.3 Mixing and Submersible Pump Installation. A mixing and submersible transfer pump will be installed into the tank once the tank interior has been washed. The liquid heel (16-24 inches) will be mixed in an effort to suspend solids residing on the tank floor. The mixed heel will then be removed with the submersible pump. See Figure 8-5.

Mixing the heel will suspend the solids. As mixing progresses, solids near the mixing pump suction will be displaced towards the perimeter of the tank. This may cause solids accumulation in the area where the tank walls and tank floor join and in the area around the cooling coil supports.

The submersible pump will be energized to transfer the mixed heel to the receiving tank. As the level in the tank is lowered, the mixing pump will begin to cavitate when the Net Positive Suction Head (NPSH) becomes inadequate. At this point, the mixing pump will be deenergized and the submersible pump will continue to remove the remaining heel until the pump loses suction. Approximately ½ - 1 inches of heel will be left in the bottom of the tank.

If solids do accumulate in certain tank bottom regions, the tank washdown arm could be reinstalled and used intermittently to wash the solids back towards the tank center for further agitation. The solids could also be directed towards the submersible pump for removal from the tank.

The mixing pump assembly will be removed and decontaminated when no longer required. The mixing pump will either be stored in a temporary shelter or relocated to the next tank scheduled for heel stabilization.

8.2.3.3.1 **Mixing Pump Description and Installation**—The mixing pump could be a one-stage vertical turbine pump that draws in the liquid heel through the foot of the pump and discharges the heel horizontally through two nozzles that are oppositely opposed. The driver for the pump would be an electric motor mounted aboveground at the tank riser. The electric motor would be stationary while a turntable assembly slowly rotates the pump inside the tank. The mixer pump would be suspended with a column of pipe. The pipe column would house the drive shaft and contain bearings to support the drive shaft within. The drive shaft would be sealed to prevent upward migration of liquid heel through the pipe column to the surface.

Initially, a single mixing pump will be installed in the centermost riser of each tank. See Figure 8-6. Since distances from the tank riser flanges to the tank floor bottom may vary from tank to tank, adjustable supports to suspend the pump will be fabricated that attach to the concrete shield currently in place at the tank risers. A second mixing pump could be installed in another riser if it is determined that additional mixing would be beneficial to suspend and remove more solids.

There may be interference or clearance problems between the mixing pump and cooling coils on the tank floor bottom. Interference with the cooling coils would prevent lowering the mixing pump assembly to within several inches of the tank floor. However, even if the mixing pump is suspended above the cooling coils, the heel will still be agitated if the liquid heel level is above the pumps NPSH.

Radiation shielding will be installed at the surface of the tank riser to reduce radiation fields. Further work is required to determine the size and type of material necessary for adequate shielding.

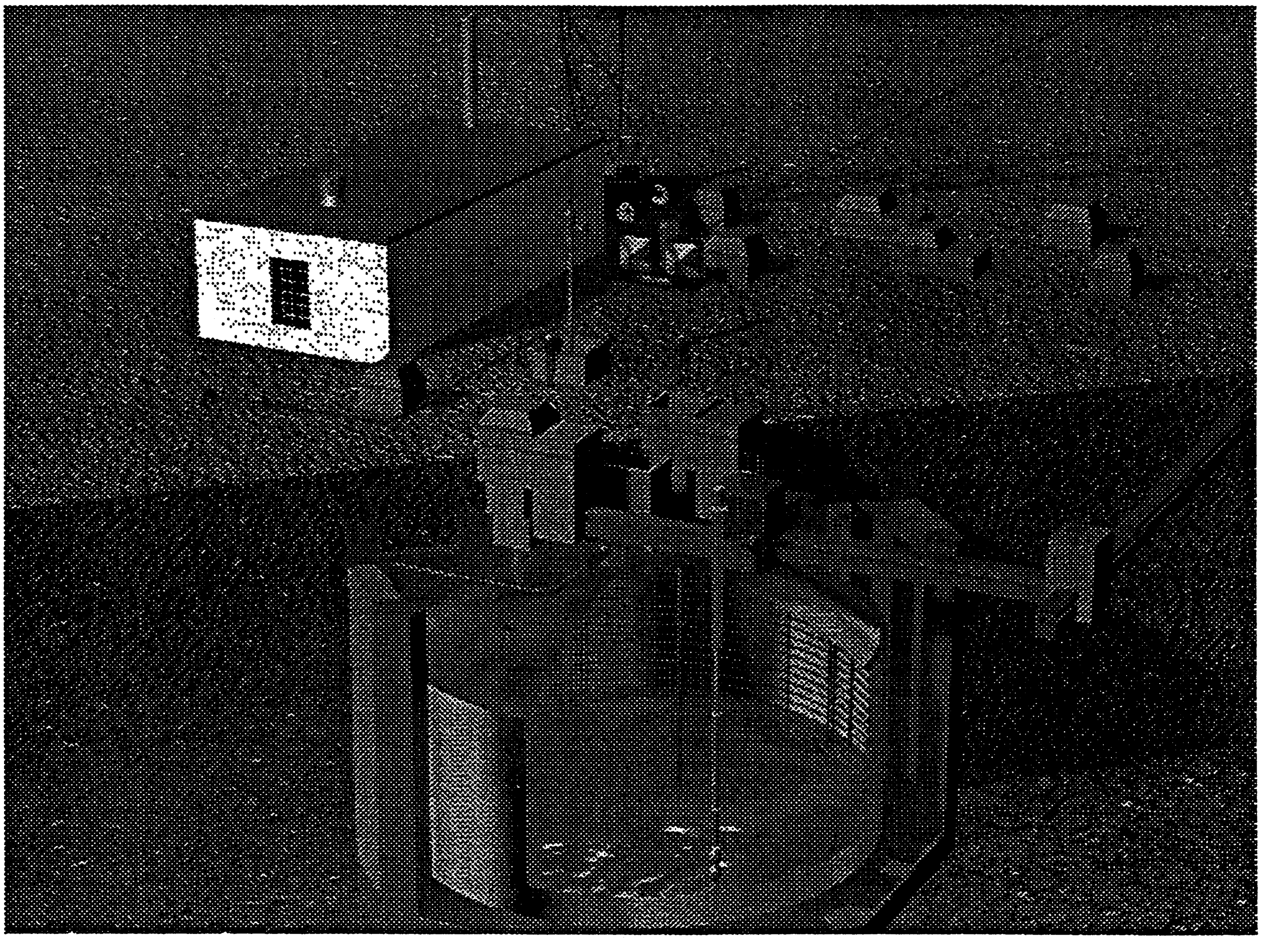


Figure 8-5. Mixing and Submersible Pumps.

8.2.3.3.2 **Submersible Pump Description and Installation**—Low cost submersible pumps capable of delivering approximately 50 gpm at 50 feet of head will be lowered through a tank riser and rest on the tank floor. The discharge line from the submersible pumps will be a double-contained flexible hose that is routed through the tank riser to the tank's associated valve box. The hose will temporarily tie into the existing waste transfer system at a valve box. The pumps will be abandoned in place upon completion of heel stabilization.

Radiation shielding will be installed at the riser where the flexible hose exits the tank. Radiation shielding such as earthen material will also be placed over the flexible hose enroute to the valve box. However, further investigation will be required to determine material types and thickness to control radiation exposures.

An additional pump could be lowered through the same riser and be situated adjacent to the original pump if it was advantageous to remove the heel at a faster rate. If a different location in the tank is preferred, a pump could be placed in another riser.

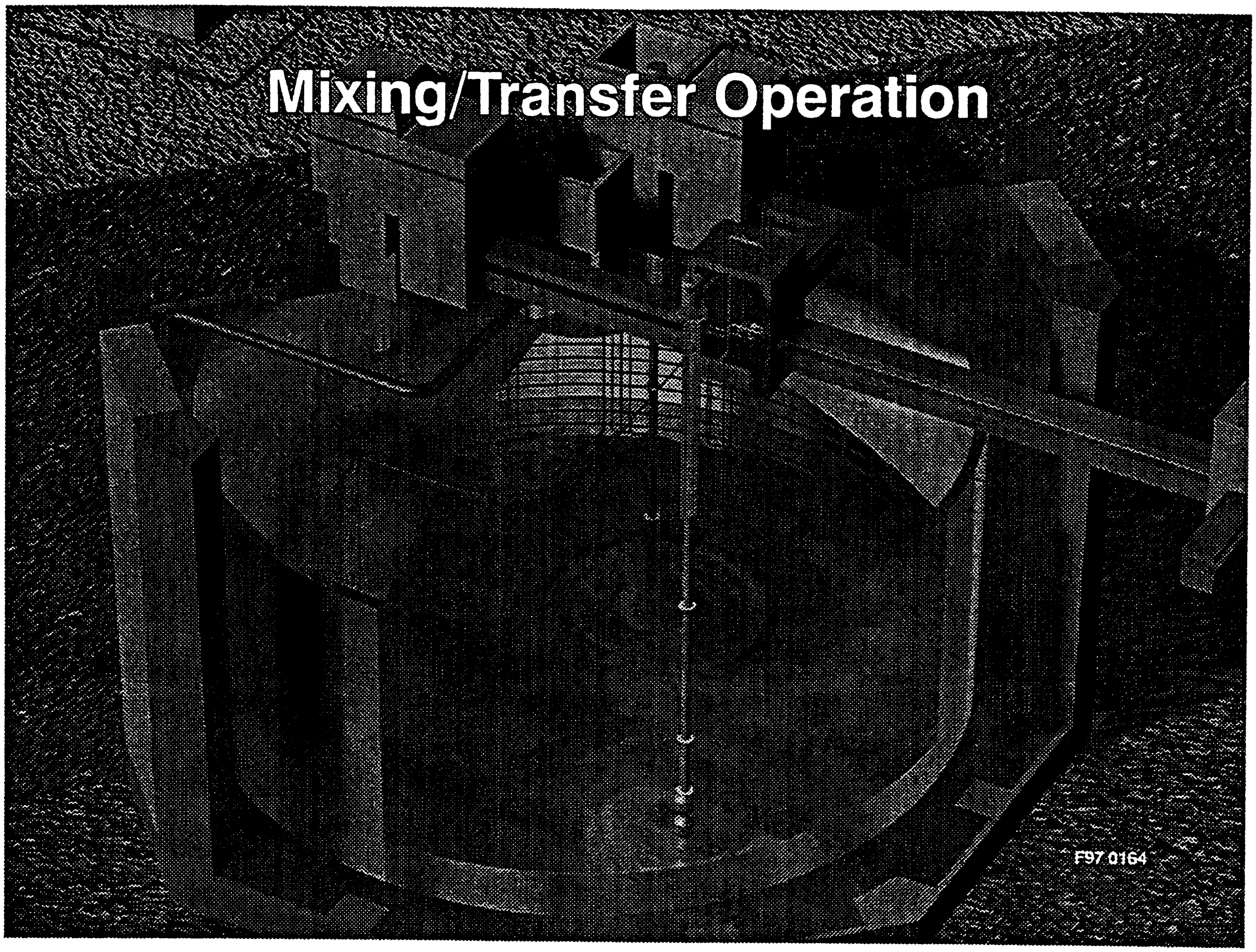


Figure 8-6. Mixing Tank Operation.

8.2.3.4 Heel Characterization. Heel samples will be taken at different stages of heel stabilization and for various reasons.

8.2.3.4.1 Baseline Heel Characterization—Heel samples will be taken from the first liquid pumped out of the tank using the submersible pump to provide a baseline characterization of the heel constituents. This baseline will be used to determine how effectively flushing reduces mixed waste concentrations and provide the starting heel pH.

Since existing equipment uses steam to transfer liquid out of the tank affecting certain volatile heel constituents and potentially tainting the characterization results, the submersible pump will be used.

8.2.3.4.2 Heel pH—A sample will be taken, as required, during flushing operations to establish (characterize) the current heel pH. Measurement of the pH will also provide a basis for estimating the liquid volume required to flush the heel in order to obtain a heel pH of 0.5 to 2.0.

8.2.3.4.3 Final Characterization—A final heel constituent characterization will occur just before heel displacement. This characterization will provide the as-is condition.

8.2.3.5 Heel pH Adjustment. Before heel displacement, the heel pH must be checked and adjusted (as required) to ensure that the pH is correct for proper setting and curing of the grout. Tank liquids are highly acidic and vary from 0.43 moles H+/liter (pH = +0.37) to 2.65 moles H+/liter (pH = -0.42). Tank liquids are acidic so that the radionuclides and heavy metals remain in solution and do not form precipitates.

Experiments[8-6] have been performed to determine the pH range needed for setup and curing of the Portland cement-based grout proposed for heel displacement. Grout placed in the heel that is too acidic will be "attacked" by the acid, eventually weakening the solidified waste form. If the heel is too basic, the grout will tend to gel wherever contact is made between the grout and heel. Therefore, it will be necessary to adjust the heel pH before displacement with grout. Grout specimens placed in different waste simulant concentrations (a solution that simulates the tank heels composition) revealed that the waste simulant pH range must be 0.5-2.0 to achieve satisfactory grout set up and curing.

The recommended heel pH-adjusting method is to flush the tank contents with water or other acceptable liquids. Contaminated basin water could be obtained from CPP-603 or FT-134 (FAST)[8-7]. Water from these sources could be transferred through existing vessels and piping. Raw water from fire hydrants or other sources could also be introduced into the tank through decontamination stubups at the tank risers. Multiple flushings will be required to reach the required heel pH (see Table 8-2). Although heel flushing with water creates more waste volume, the waste volume resulting from these flushes can be concentrated in the HLW and PEW evaporators.

Another possible heel pH-adjusting method would be to treat the heels by adding a chemical base such as ammonium hydroxide (NH_4OH). Mixing between the chemical base and acidic heel would be passive unless a temporary mixing system is installed. Concerns related to treating the heel with a chemical base that must be resolved before this could be considered a viable method for adjusting the heel pH. Issues such as heat generation, precipitation of solids, and chemical base selection require further study. If the heel and base are not mixed, precipitates with radionuclides and heavy metals (lead, mercury) could form in the region where the chemical base is introduced to the heel. Heat produced by the acid-base reaction could be removed by cooling coils located in eight of the 11 tanks. Excessive heat generation in the other three tanks could be a potential problem.

Although flushing with water will create a dilute waste that must be processed, the associated risks appear to be less than if the heel pH were adjusted using a chemical base.

8.2.3.5.1 Flushing Calculations—Flushing calculations were performed[8-8] to bound the water volume required to achieve a tank heel pH of 2.0 for the tank with the highest acidity (WM-188, pH = -0.42) and maximum cease use heel volume. These calculations estimate the flushings required for Scenario A. It should be noted that the actual heel flushing method may vary from what is presented here. Further study will be required to minimize the water volume required for flushing operations.

The calculations begin with an initial heel volume of 15,000 gallons. Twelve thousand gallons of water is then added to the heel by the tank washing process, bringing the total diluted heel volume to 27,000 gallons. Then 25,800 gallons is transferred out of the tank leaving behind 1,200 gallons of diluted heel. Thirteen thousand five hundred gallons is then added to dilute the heel. Thirteen thousand five hundred gallons of diluted heel is then transferred out. The process of adding 13,500 gallons and then transferring the diluted heel out is repeated until the desired pH level has been achieved.

Table 8-2. Flushing calculations for the most acidic tank (WM-188).

Initial Heel Volume = 15,000 gal	Final Heel Volume = 1,200 gal
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter	Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)

(moles H^+/liter)$_s$ = (moles H^+/liter)$_{s-1}$ x (heel volume)$_s$ / [(heel volume)$_s$ + (liquid added)$_s$] where s = current step, $s-1$ = previous step

Flush Volume = 13,500 gal/flush

Step #	Action	Heel Volume (gal)	Liquid Added (gal)	Liquid Removed (gal)	Total Tank Liquids (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
1	Starting Conditions	15,000			15,000	2.6500	-0.42
2	Tank Washdown	15,000	12,000		27,000	1.4722	-0.17
3	Remove Liquid With Submersible Pump	1,200		25,800	1,200	1.4722	-0.17
4	1st Flush of Heel	1,200	13,500		14,700	0.1202	0.92
5	Remove Liquid With Submersible Pump	1,200		13,500	1,200	0.1202	0.92
6	2nd Flush of Heel	1,200	13,500		14,700	0.0098	**2.01**
7	Remove Liquid With Submersible Pump	1,200		13,500	1,200		
			39,000	52,800			

Note: Washing the tank with 12,000 gal of liquid followed by two 13,500-gal flushes adjusts the pH from -0.42 to the target pH of 2.01. The volume of liquid that would be added is 39,000 gal.

The results of these calculations are shown in Table 8-2.

The above calculations indicate that two flushes will be required to increase the heel pH from -0.42 to 2.01. Based on an initial heel volume of 15,000 gallons, about 39,000 gallons of additional diluted waste will be generated.

8.2.3.6 VOG System. A temporary VOG system will be connected to the tank(s) undergoing closure (see Figure 8-7 for a temporary VOG system layout.). A brief description of the existing TFF VOG System and temporary VOG system are presented below. A detailed description of the temporary VOG System can be found in of Appendix D.

8.2.3.6.1 Existing VOG System—The existing TFF VOG System consists of a blower and piping network that maintains a negative pressure in the 300,000-gallon tanks. Blowers located in CPP-604 create a negative pressure of up to a 0.5-in. water column (WC) to remove gases from the 11 storage tanks. This system prevents the release of radioactive and hazardous material into the air when tank risers are opened or if leaks in the tank system were to occur. Gases from the tank are transported through the Atmospheric Protection System (APS) and routed through HEPA filters in CPP-649. After passing through the HEPA filters, the gases are then sent to the CPP-708 stack for safe discharge.

The existing VOG system maintains a negative pressure of about a 0.5 inch-WC when the tank system is sealed. When a tank riser is opened (to inspect corrosion coupons, perform an in-tank video inspection, etc.), the existing VOG system does not maintain an adequate negative pressure in the rest of the tanks. Liquid waste transfers into or out of the tanks are not permitted under these conditions. Typically, risers are opened for a short time period (up to 20 hours or two 10-hour shifts).

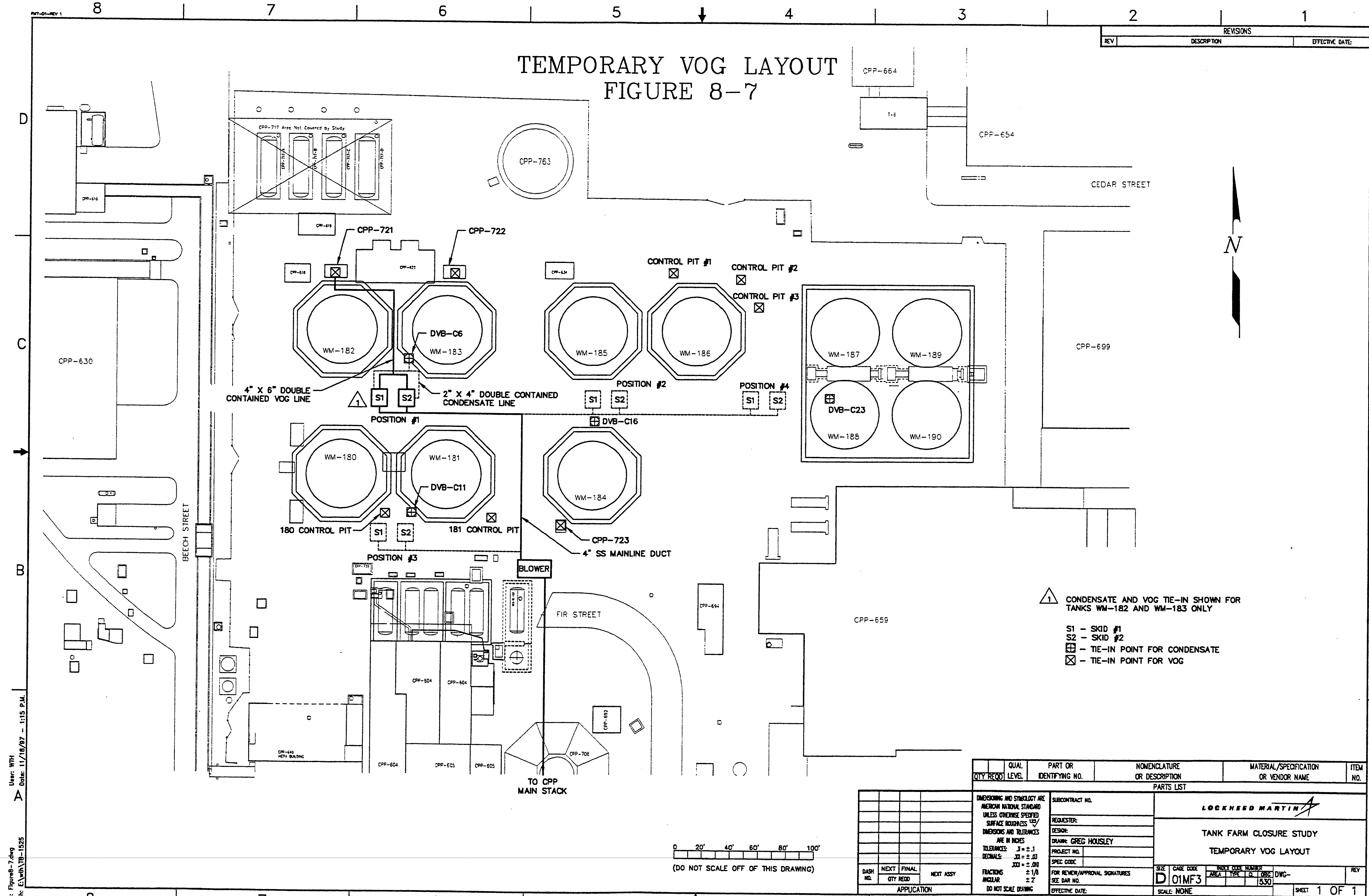
Several risers may be opened simultaneously during closure operations. The existing system will not provide release protection under these circumstances and will affect ongoing TFF operations. To reduce the impact on normal TFF operations, a separate temporary VOG system will be installed to service tanks undergoing closure.

8.2.3.6.2 Temporary VOG System—A temporary VOG system will be connected to the tank(s) undergoing closure activities to provide the necessary negative airflow when risers are opened (see Figure 8-8). The tank(s) undergoing closure will be permanently disconnected (isolated) from the existing VOG system. Tanks still in service will remain connected to the existing VOG system.

The temporary VOG system will consist of two portable filter skids, two fixed blowers, new shielded and unshielded piping, and equipment enclosures. Lead blankets may be used to provide the necessary shielding.

The skid-mounted filter units will be designed to serve two tanks simultaneously. One filter skid unit will exhaust the tank undergoing heel stabilization activities, while the other filter skid will exhaust the next tank being prepared for heel stabilization. The filter skids will be located near the tanks to minimize the double-contained piping length running between the VOG tie-in points and the filter skids.

Blowers will be installed between the tanks and the main stack. The blowers will be stationary throughout the project whereas the filter skids will be repositioned as necessary. The blowers will be housed in an insulated, prefabricated enclosure that rests on a concrete pad. The enclosure will be equipped with lighting, heating, and ventilation.


TEMPORARY VOG LAYOUT
FIGURE 8-7
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
CPP-664
T-6
CPP-654
CEDAR STREET
N
CPP-763
CPP-717 Area Not Covered by Study
CPP-616
CPP-630
CPP-721
CPP-722
CONTROL PIT #1
CONTROL PIT #2
CONTROL PIT #3
WM-182
WM-183
DVB-C6
WM-185
WM-186
WM-187
WM-189
DVB-C23
WM-188
WM-190
CPP-699
4" X 6" DOUBLE CONTAINED VOG LINE
2" X 4" DOUBLE CONTAINED CONDENSATE LINE
S1
S2
POSITION #1
POSITION #2
POSITION #4
DVB-C16
WM-180
WM-181
DVB-C11
WM-184
180 CONTROL PIT
181 CONTROL PIT
CPP-723
4" SS MAINLINE DUCT
POSITION #3
BLOWER
BEECH STREET
FIR STREET
CPP-659
CPP-604
CPP-605
CPP-708
CPP-692
CPP-646 HEPA BUILDING
TO CPP MAIN STACK
CONDENSATE AND VOG TIE-IN SHOWN FOR TANKS WM-182 AND WM-183 ONLY
S1 - SKID #1
S2 - SKID #2
- TIE-IN POINT FOR CONDENSATE
- TIE-IN POINT FOR VOG
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(DO NOT SCALE OFF OF THIS DRAWING)
QTY REQD
QUAL LEVEL
PART OR IDENTIFYING NO.
NOMENCLATURE OR DESCRIPTION
MATERIAL/SPECIFICATION OR VENDOR NAME
ITEM NO.
PARTS LIST
DASH NO.
NEXT ASSY
FINAL
QTY REQD
NEXT ASSY
APPLICATION
DIMENSIONING AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD
UNLESS OTHERWISE SPECIFIED SURFACE ROUGHNESS 125
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING
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REQUESTER:
DESIGN:
DRAWN: GREG HOUSLEY
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:
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TANK FARM CLOSURE STUDY
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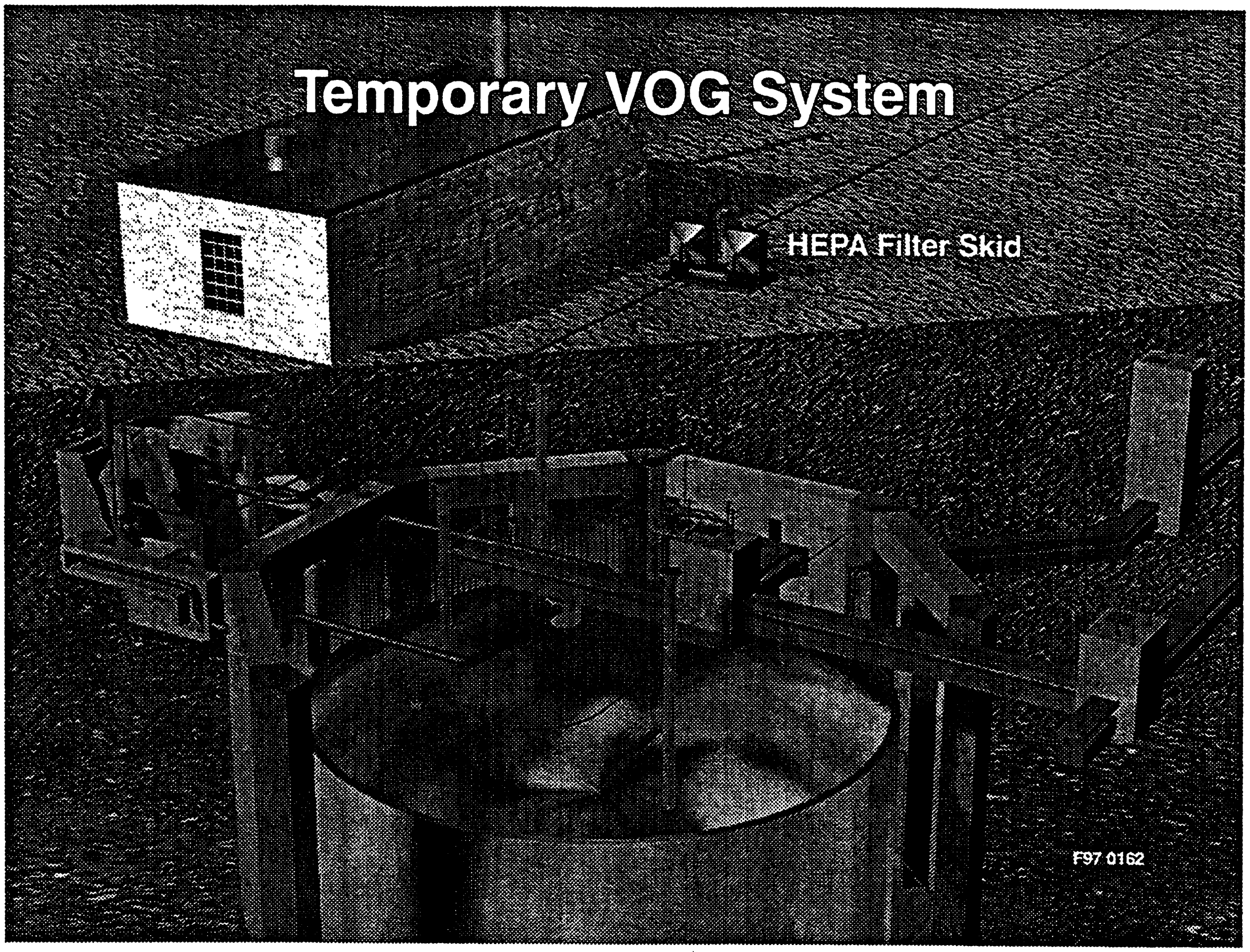


Figure 8-8. Temporary VOG system.

8.2.3.7 *Existing Equipment Removal.* Existing equipment will be removed from tank risers to make room for video equipment, tank lighting, grouting equipment, and pumps. The following equipment will be removed from the risers:

- Radiofrequency probes
- Corrosion coupons
- Steam jets (Only if access to that riser is required.)
- Airlifts.

Existing tank equipment removal will follow a preplanned, sequential procedure. Steam jets may be left in place for use in tank washdown and then removed, if required, at a later time. Existing level probes could be used during tank wash down. Some tanks have operable temperature probes that could be used to monitor tank temperatures during the grouting phase. Steam jets and airlifts will be among the last pieces of existing equipment removed from the tank.

The following steps will be taken to remove existing equipment from abovegrade risers:

- Lock and tagout instrumentation power and equipment valves
- Remove concrete riser shield cover
- Remove riser flange cover and verify air flow goes into riser (i.e., temporary VOG system operating properly)
- Position and attach crane hook to in-tank equipment, disconnect equipment from the tank, decontaminate equipment as it is slowly removed from the riser, and encase equipment in sealable sleeving
- Dispose of sleeved equipment as necessary
- Install new equipment (if available) in riser; otherwise, replace riser flange cover and concrete shield cover.

The following steps will be taken to remove steam jets and airlifts:

- Lock and tagout valves to steam jets and airlifts
- Excavate soil above riser, remove concrete shield cover
- Cut waste transfer, steam, and air piping; weld cap on steam and air piping
- Position and attach crane hook to the steam jets and air lifts, decontaminate steam jets and air lifts while slowly removing from riser, encase steam jets and air lifts in sealable sleeving
- Dispose of sleeved steam jets and air lifts as necessary
- Replace riser flange cover and concrete shield cover.

8.2.3.7.1 Removed Equipment Decontamination—Initial decontamination of equipment located inside the tank risers could be conducted through using the decontamination stubups at each tank riser. The stubups have an external connection with a discharge outlet located inside the tank risers. As equipment is raised up through a riser, it would be initially flushed with a decontamination solution such as water. An accordion-shaped plastic sleeve (or bag) would be placed over the equipment as it is withdrawn from the riser. The sleeve will serve to contain radioactive contaminants that remain from initial flushing efforts.

A decontamination area will be set up to clean equipment removed from the tanks. Removed equipment can then be sized and placed in appropriate containers for future disposal. These containers will be temporarily stored in designated, controlled areas with limited access.

8.2.3.7.2 Tank Riser Decontamination—The risers will be decontaminated to eliminate radioactive wastes that may have been deposited during existing tank equipment removal. Riser decontamination will occur before placing heel displacement equipment (video equipment, lighting, wash down arm, grout delivery arm, etc.,) inside the risers. Equipment installation inside decontaminated risers should reduce future cleaning efforts when the equipment is subsequently removed for use in another riser.

8.2.3.8 *Video Equipment and Tank Lighting.* Video equipment will be required to assist in remote closure and void filling activities that take place inside the tank. Remote in-tank activities will include closure operations such as equipment installation and operation, tank washdown, and grout placement. Video equipment could also be used to document the conditions inside the tanks before and after tank washdown and grouting.

Video equipment will consist of in-tank equipment such as closed circuit television cameras and lights, in addition to control trailer equipment such as video monitors, video recorders, and the control system for remote video operation.

In-tank 3-D video equipment will be installed in the 12-inch tank risers. Field measurements indicate that some risers have inside diameters less than 12 inches. To allow for risers with smaller diameters, the video equipment will be designed to fit in a riser with a maximum inside diameter of 10.5 inches.

In-tank video equipment will be composed of two charged coupled device (CCD) color cameras, mast assembly, pan and tilt units, and high efficiency metal halide focused beam lamps. The cameras will be equipped with remote-controlled zoom, iris and focus adjustments. The pan and tilt units will provide for a 360-degree field of view with a -90/+90-degree elevation. The mast assembly will contain the wiring associated with the cameras, lamps, and pan and tilt units. Provisions will be made to clean the camera lens and tank lighting.

Video equipment located in the control trailer will consist of a video monitor, video recorder, 3-D video processing system, and remote controls for the cameras and lights. A viewing monitor and controls for the camera and lighting will also be placed near the riser location where equipment such as the grout delivery arm or tank washdown system is installed. Personnel located near the risers during tank washdown or grouting will be able to manipulate the cameras as necessary to observe activities inside the tank.

A video recorder will provide the opportunity to document and review previous operations in other tanks. If necessary, revisions may be made to equipment or procedures in order to improve heel stabilization and void filling processes.

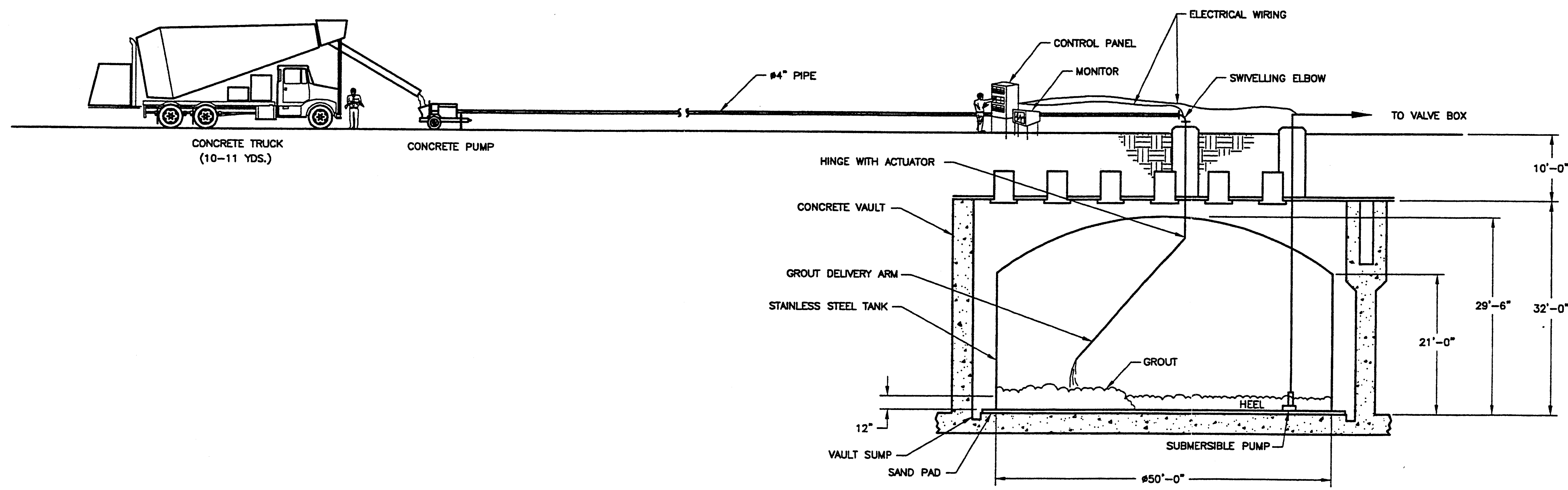
8.2.3.9 *Tank Preparation Activity Completion.* Tank preparation activities will be complete at this stage. A temporary VOG system will maintain a slight negative pressure inside the tank to ensure that air flows into the tank whenever risers are opened. Existing equipment has been removed from the risers and the risers are ready to accept heel displacement equipment. Video equipment has been installed to monitor activities that take place inside the tank. The heel pH has been adjusted in preparation for the next stabilization task.

The next task in heel stabilization is to solidify the heel using grout.

8.2.4 Heel Displacement

A heel will remain in the tank that is approximately 1/2 – 1 inches deep with a pH between 0.5 and 2.0. Wet grout will be transported through a 2 to 4-inch pipeline to the delivery arm located in the tank's centermost riser. The maneuverable delivery arm will place grout to displace the remaining heel towards the submersible pump (see Figure 8-9).

HEEL DISPLACEMENT
FIGURE 8–9



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TANK FARM CLOSURE STUDY
HEEL DISPLACEMENT

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8-31

The submersible pump will continue removing the displaced heel until the suction is plugged with grout. Any free heel liquids will be localized near the submersible pump. The low-cost submersible pump will be abandoned in place. The power cable and flexible hose will be disconnected and dropped into the tank.

Any free liquids remaining on top of the solidified heel will be absorbed with dry grout. A maneuverable dry grout delivery arm will be inserted into the same riser where the submersible pump was installed. With the aid of the remote camera, the delivery arm will be maneuvered to disperse dry grout on the remaining free liquids. After the dry grout has been placed, the delivery arm will be removed and decontaminated.

As a final step, a layer of 3 to 4-inches thick grout will be poured over the solidified heel to absorb any remaining dry grout that was placed in the previous step. Wet grout will be transported through the pipeline to the grout delivery arm located in the centermost riser. Additional grout will be added to cover any horizontal cooling coils that protrude through the solidified heel by 3 to 4 in.

The wet and dry grout will be formulated to set up and cure with a compressive strength of at least 500 psi. A 12-in. thick grout layer will occupy a volume of approximately 72 yd^3. The total volume of grout required to displace the heel and cover the cooling coils will be about 100 yd^3.

8.2.4.1 Equipment Removal and Decontamination. When the 4–12-inch layer of wet grout has been poured on top of the solidified heel, the grout delivery arms will be removed and decontaminated as necessary. After removal and decontamination, the arms will then be either stored in a temporary shelter or relocated to the next tank scheduled for heel displacement.

The flange covers will then be placed on the risers and the concrete shield covers returned to their position on top of the risers. Void filling will be the next activity to take place in the tank.

8.2.4.2 Completion of Heel Stabilization. Once the equipment from the tank has been removed and decontaminated, the risers sealed, the temporary VOG system disconnected, and a HEPA filter installed, heel stabilization activities for the tank will have been completed.

Preparatory work for the next tank in sequence will begin during heel stabilization activities for the current tank. When equipment for the tank undergoing heel stabilization is no longer required at that tank, it will be relocated to the next tank in the closure sequence.

8.2.4.3 Grout Composition And Characteristics. Laboratory experiments identified in Section 8.2.3.5 revealed that the heel pH range should be between 0.5 and 2.0 for optimal grout set up and curing.

Following the NRC recommendations[8-9] for LLW that has been stabilized in grout or cement, the compressive strength of the solidified heel and cover must be at least 500 psi. Since the tank void above the solidified heel will be filled with a material such as clean or LLW grout, the solidified heel's compressive strength must be at least 500 psi in order to support the overlying material. In addition, free liquids must be absent in the solidified grout.

Excess heat generation is not anticipated since the solidified heel will be approximately 12-inches thick. Filling remaining tank void with clean or LLW grout is not expected to happen immediately after heel displacement and therefore the solidified heel should have an adequate period of time to release any excess heat and cure properly. Curing the solidified heel for 28 days will allow the grout to obtain at least 75% of its final compressive strength.

Below are brief descriptions of different grouts that may be used for solidifying the heels. Further testing and evaluation will be required to verify that the grout will meet performance criteria. Tests to determine the optimum heel pH for proper grout set up and curing testing will be conducted on sample grout specimens. When set and cured, the solidified grout must have adequate compressive strength (>500 psi) to ensure a stable base for support of overlying materials when the remaining tank void is filled.

8.2.4.3.1 Typical Heel Grout—A grout formulation has been identified that could be used to displace the remaining tank heel. This typical grout would have equal parts of Portland cement, blast furnace slag, and fly ash. By weight, 40 pounds of water is added per 100 pounds of solid mixture. The basic constituents, by weight, are shown in Table 8-3.

The basic constituents, by weight, are shown in Table 8-3.

8.2.4.3.2 Typical Concrete—Since the liquid heel will be mainly displaced by grout and removed by either pumps or jets, the grout will be mainly a "filler" in the tank bottom. Therefore, a concrete mix similar to what is available at a "Ready Mix" batch plant could be used as a substitute grout. The approximate formula for this grout is shown in Table 8-4.

The concrete must be pourable and self-leveling. Therefore, the gravel used in the aggregate must be rounded and not a crushed rock since crushed rock tends to pile and will not spread out uniformly.

8.2.4.3.3 Reducing Grout—A reducing grout was made to stabilize the heel at Savannah River. The reducing grout was formulated to absorb 30% of its volume in liquids, resolving the problem of standing residual liquids. The heel at Savannah River was basic, whereas the heels in tanks at CPP are acidic. Testing and experimentation will be necessary to determine if the reducing grout would be acceptable for use in solidifying the heels. Flowability could be a concern since the grout has a lower water content than the typical grouts.

The formula for the reducing grout used at Savannah River is shown in Table 8-5.

Table 8-3. Formula for heel displacment grout.[8-10]

Material	Weight (lb)
Portland Cement – Type I/II	33.3
Blast furnace slag	33.3
Fly ash	33.3
Water	40.0
Plasticizier	15.20

Table 8-4. Formula for "Ready Mix" type concrete.[8-10]

Material	Weight (lb)
Portland Cement – Type I/II	15.0
Aggregate[a]	46.0
Sand	39
Water	9.0

Table 8-5. Reducing grout formula used at Savannah River.[8-11]

Material	Weight (lb)
Portland Cement – Type 5	1,353
Masonry sand	1,625
Slag	209
Water	720

8.3 Vault Void Management

Tank and vault voids will remain after the tank isolation (Section 8.1) and heel stabilization (Section 8.2) tasks are complete. The vault void is defined as the space between the vault and the tank. Vault void management completion defines the point of RCRA closure (see Section 2) for the purposes of this study. This section deals with the management of the vault voids and is applicable to Options 2 through 6.

8.3.1 Accessing the Vault Void

This section discusses the passive air filtration system, accessing the vault void and grouting the vault void. Vault void grouting forms a cap or cover that encases the tank. This cap or cover minimizes water infiltration, prevents subsidence, and restricts entry into the tank. Tank buoyancy, grouting above the tank dome, and pipeline cleanups are also addressed.

8.3.1.1 Passive Air Filtration System. The vaults contain radioactive contamination and are not currently exhausted to the atmosphere. Air displaced during vault grouting operations must be HEPA filtered before release to the environment. A passive HEPA filter will be installed before accessing the vault. The passive air filter will be connected to an existing vault riser. The HEPA filtration will be sized to allow displaced air (approximately 72 ft^3/min) to pass through with minimal impedance. Otherwise, the displaced air may take a less impeded path to release, since it is assumed that the vaults are not airtight.

8.3.1.2 Vault Void Access. The vault void is accessed either by the vault risers or the manway. Vault risers are 12-inch diameter pipes that connect the vault interior and rise at least 15 inches abovegrade. A removable concrete cap covering each vault riser must be removed to gain vault access. One to three risers currently exist in each vault. Vault risers usually contain equipment such as sump pumps, liquid transfer and instrumentation lines. This equipment must be removed to allow for video, lighting installation, and void filling equipment. One to three additional risers, bringing the total access risers to four or five, will be installed into the vault. The risers will be equally spaced around the vault void perimeter to ensure equal grout distribution.

Each vault has a manway that can provide access to the vault. These manways are located approximately 10 ft belowgrade and would require excavation in radioactive contaminated soil. Using the manways for vault access was eliminated from consideration for the following reasons:

1. High radiation exposure potential
2. Buried pipeline interference
3. Load limitation for excavating equipment (small backhoe or hand excavation)
4. Relative high cost without commensurate benefit.

Existing and new risers will provide the required access. Using as many of the existing vault risers will reduce worker radiation exposure by keeping soil excavation to a minimum.

8.3.2 Vault Decontamination

It is assumed that vault void decontamination will not be required for Options 4 through 6 as these options create a landfill. The vault waste volume when compared to the tank waste volume should be very small and has been assumed to be within the ICPP CERCLA risk assessment criteria covering the TFF. Any vault contaminants will be covered with clean grout and CERCLA will install a long term cap over the entire TFF. Options 2 and 3 will, however require vault decontamination. These options are covered in Section 7.2.

8.3.3 Tank Monitoring

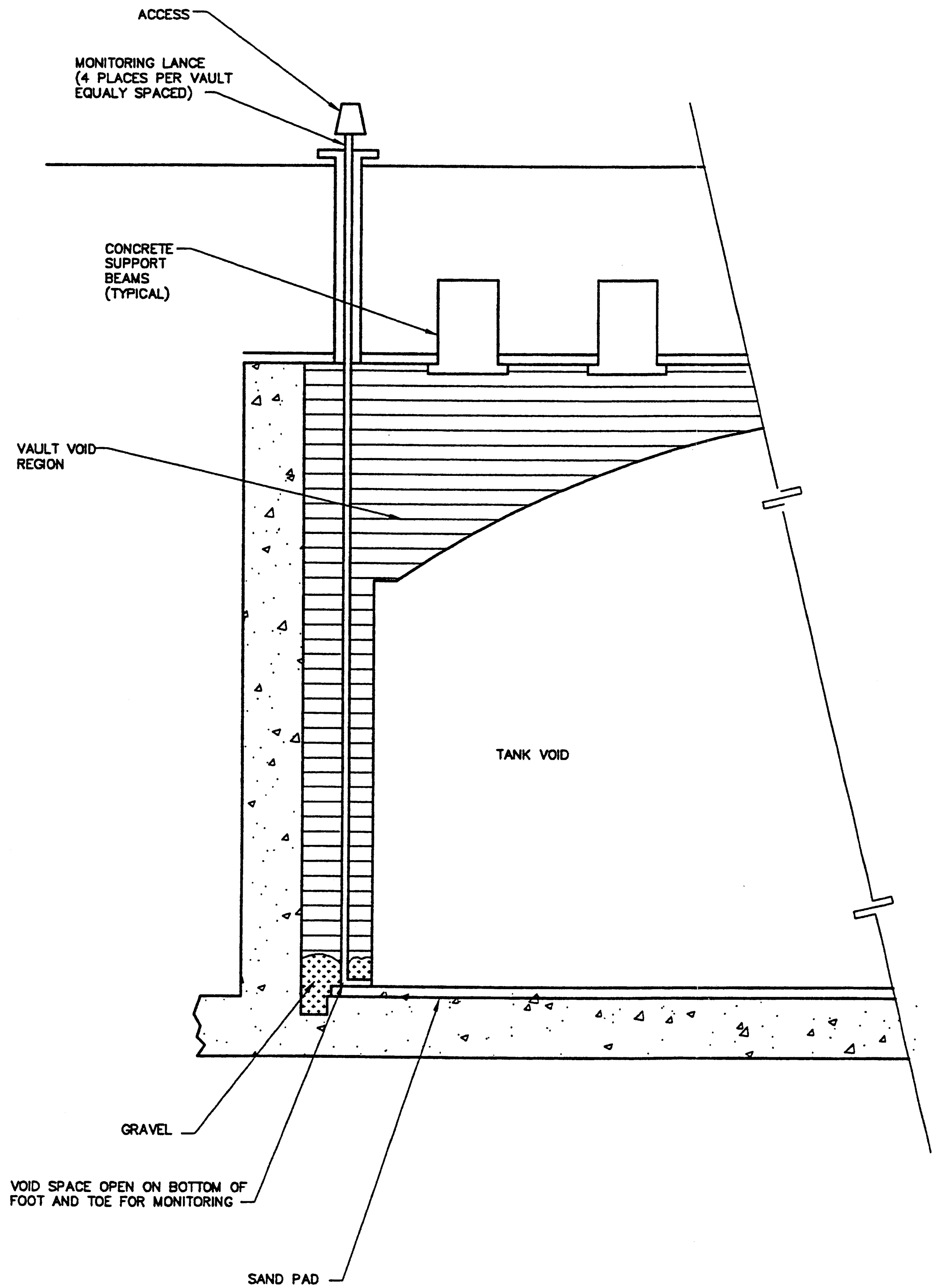
Tank monitoring will be provided for Options 2 through 6 (see Figure 8-10). Options 2 and 4 install LLW and require tank monitoring. Monitoring will be provided for the other three options as a best management practice. There will be four lances installed through equally spaced risers. Gravel will be placed over the ft of each lance. The gravel will then be covered with grout to seal the region from vault filling operations. The lance bottom and toe regions are left open. This allows direct access to the vault bottom and tank edge.

8.3.4 Vault Void Filling

Vaults will be filled with grout to

1. Minimize subsidence issues associated with tanks WM-182 through WM-186
2. Minimize water infiltration

TANK MONITORING LANCE
FIGURE 8–10



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TANK FARM CLOSURE STUDY
TANK MONITORING LANCE

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3. Provide a temporary cap which will allow leaving the tank void empty for future use

4. Encapsulate the tank, including the sand under 9 of the 11 tanks, between the newly poured grout and the vault floor.

WM-182 through WM-186 vaults run a higher risk of collapse.[8-12] Collapse is expected at the bottom of the vault walls. Filling the vault eliminates this risk by reinforcing the walls with a solid grout ring.

A preliminary analysis was conducted on the tank structural capability.[8-13] This analysis was conducted to verify that the vault could safely be filled with out affecting the tank and to identify any filling constraints associated with filling operations. This analysis indicated that the vault void must be filled in lifts. An additional analysis was conducted to establish tank floating prevention criteria.[8-14] This analysis identified that the first lift height would be 18 inches to prevent floating the tank. These reports provide guidance on the number and height of each lift. Additional analysis is required to establish the best lift height combinations.

Vault filling on WM-182 through WM-186 was assumed to occur together. Filling equipment will be placed (see Figures 8-11 and 8-12) to allow continuous pouring of all five vaults. The first vault would be filled from four locations as indicated on Figure 8-11. Each location would receive a predetermined grout volume then a manifold would switch flow to the next fill point and so on until that vault was filled to the specified lift height. A pig would be used to clean the piping of the vault just filled. A pig is a device placed inside the pipe to remove the remaining grout from the fill lines. One vault will be filled to the specified lift height, continuing until all five are completely filled.

The last 6 tanks would be filled in the same manner. Grout filling equipment would be cleaned when the equipment is expected to lay idle.

8.3.4.1 Vault Void Fill Materials. A grout based fill material will be placed in the vault void once adequate vault access is obtained. This grout will encase the tank to provide a temporary cap around the stabilized heel (see RCRA landfill standards in Section 5). Proper grout placement must be evaluated and prototype testing performed to develop the actual vault filling process. The following are void fill material requirements:

1. Pumpable—Provide a low viscosity fill material that can be transported by pumping

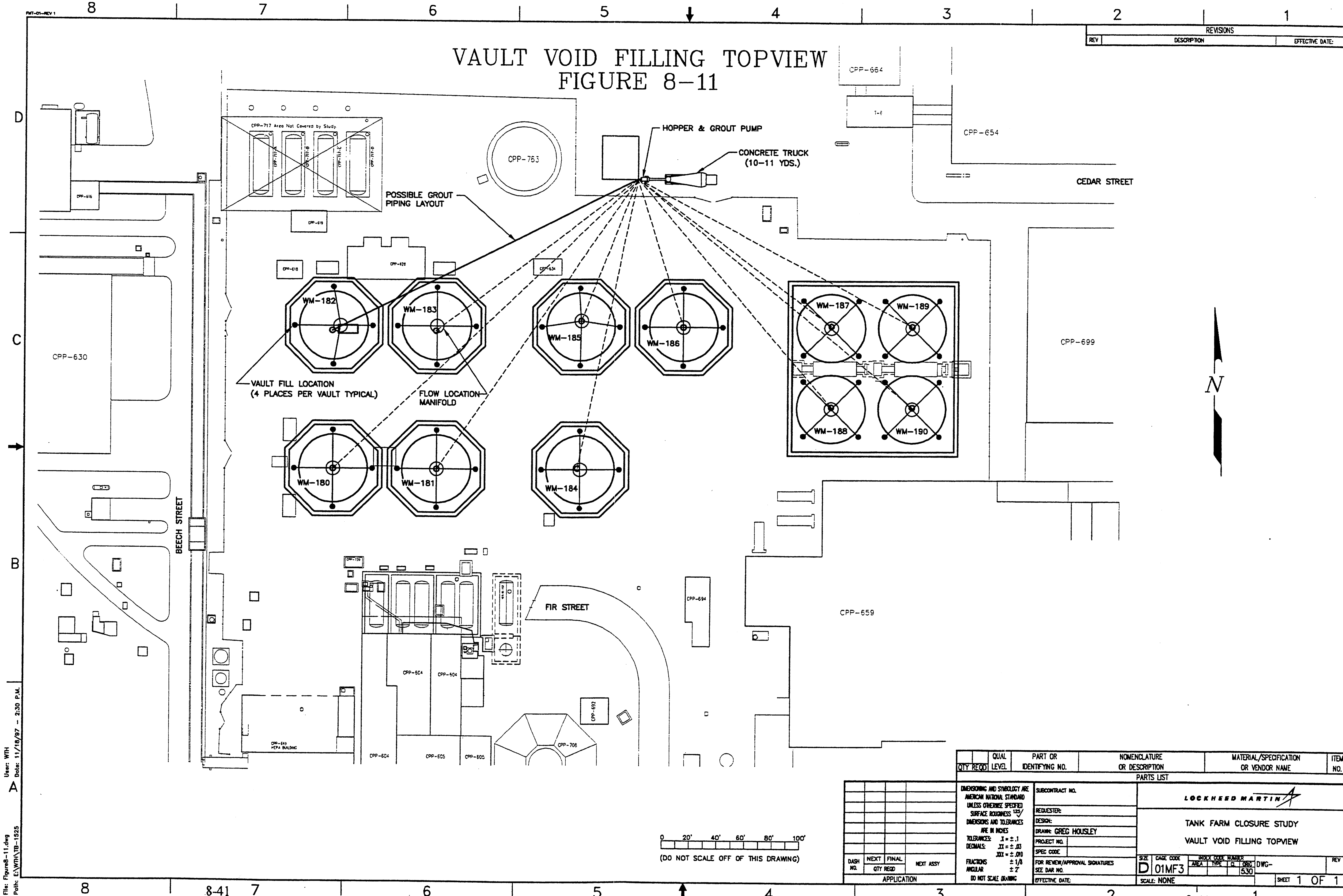
2. Self-leveling—Fill material slump must not exceed 1-in. in height between vault risers

3. Structural strength—Capability to support its own weight including other structural loads

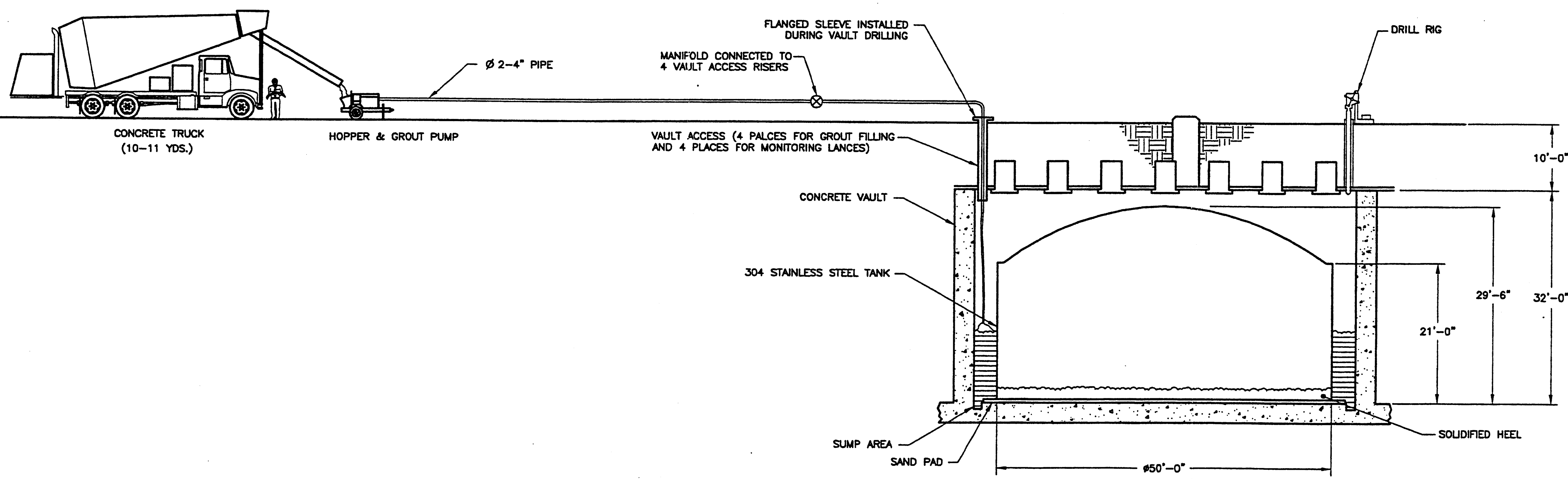
4. Low water permeability—Minimizes water migration through the fill material

5. Minimal shrinkage—Minimizes gap formation between the fill material and the tank

VAULT VOID FILLING TOPVIEW
FIGURE 8-11



VAULT VOID FILLING
FIGURE 8-12



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TANK FARM CLOSURE STUDY
VAULT VOID FILLING

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6. Minimize air pocket formation—Minimizing air pocket formation will reduce chances of water migration

7. Minimal bleed water—Bleed water will require additional processing that could create additional waste.

The grout assumed for this study will best meet the above requirements and is found in Table 8-6.

This particular grout formulation was designed to fill room voids in the WCF (Waste Calcine Facility) currently being closed to landfill standards.[8-12] The decision to use this grout for the WCF was based on laboratory work and testing on 1 and 2 yd^3 grout batches. This type of grout is desirable for void filling because it uses standard materials provided by any concrete supplier. It is relatively inexpensive ($70-80/$yd^3$), is formulated to be pumped into voids, and has excellent compressive strength. Grout strength depends upon the quantity of cement, the quantity of water relative to the cement content and the grout density.[8-16] Since water permeability is proportional to grout strength, this grout should perform well in preventing water infiltration into the vault void. The grout has a low enough viscosity to minimize the formation of air pockets. The grout's self-leveling properties will allow void spaces to be filled to the vault roof. Testing shows that grout shrinkage is minimal (0.37%. vertical shrinkage). This shrinkage rate should be acceptable but will require additional research and testing to verify.

The amount of cement in the grout determines the amount of heat generated by the grout through hydration. Grout allowed to exceed boiling temperature 100°C (212°F) will fall below acceptable structural standards. The amount of grout that can be poured into a void at one time is therefore limited. Because of the similarities of the WCF, 4 feet of grout will be used as the vault void grout limit (tank void empty). A detailed thermal analysis and/or testing should be performed to verify that heat generation will not exceed acceptable levels.

After a grout lift, a cooling period must be allowed for the heat produced to dissipate. For WCF grout this waiting period is approximately 7 days. Seven days will, therefore, be assumed acceptable for TFF Closure operations.

Table 8-6. Vault void filling grout.[8-15]

Void Filling Grout			
Specific Weight	130-134	lb/ft^3	
Comp. Strength	2,450–4,700	psi	28 day strength
Cost	70–80/yd^3		
Formula	320	lb/yd^3	Type 1-2 Cement
	640	lb/yd^3	Class S Fly Ash
	2,200	lb/yd^3	Sand
	430	lb/yd^3	Water
	4	lb/yd^3	High range water reducer
	4	lb/yd^3	Midrange water reducer

8.4 Tank Void Management

Tank void management includes filling the eleven 300,000-gallon waste storage tank voids as required by Options 2-6. Void filling materials discussed are:

1. LLW (NRC) Class C grout (Options 2 and 4)

2. Clean grout (Option 6)

3. CERCLA material (Options 3 and 5).

Option 6 grouts the tank and vault voids at the same time. The tank void is defined as the space inside the tank structure remaining after heel stabilization. Filling the tank void with LLW or CERCLA waste would require the creation of a landfill. Tank void grouting will prevent long-term subsidence of the TFF by removing any voids that could collapse over time. A discussion follows on TFF tank void management.

8.4.1 Tank Void Access

This section discusses items required for tank void access.

8.4.1.1 VOG System. Before tank access can be attained, the temporary VOG system must be connected to a tank riser and operational. Once operational, the VOG system must maintain a negative tank pressure, while the tanks are open to the outside atmosphere. The VOG systems function is to insure airflow into the tank through any tank opening. More detailed information on the VOG system can be found in Section 8.2.

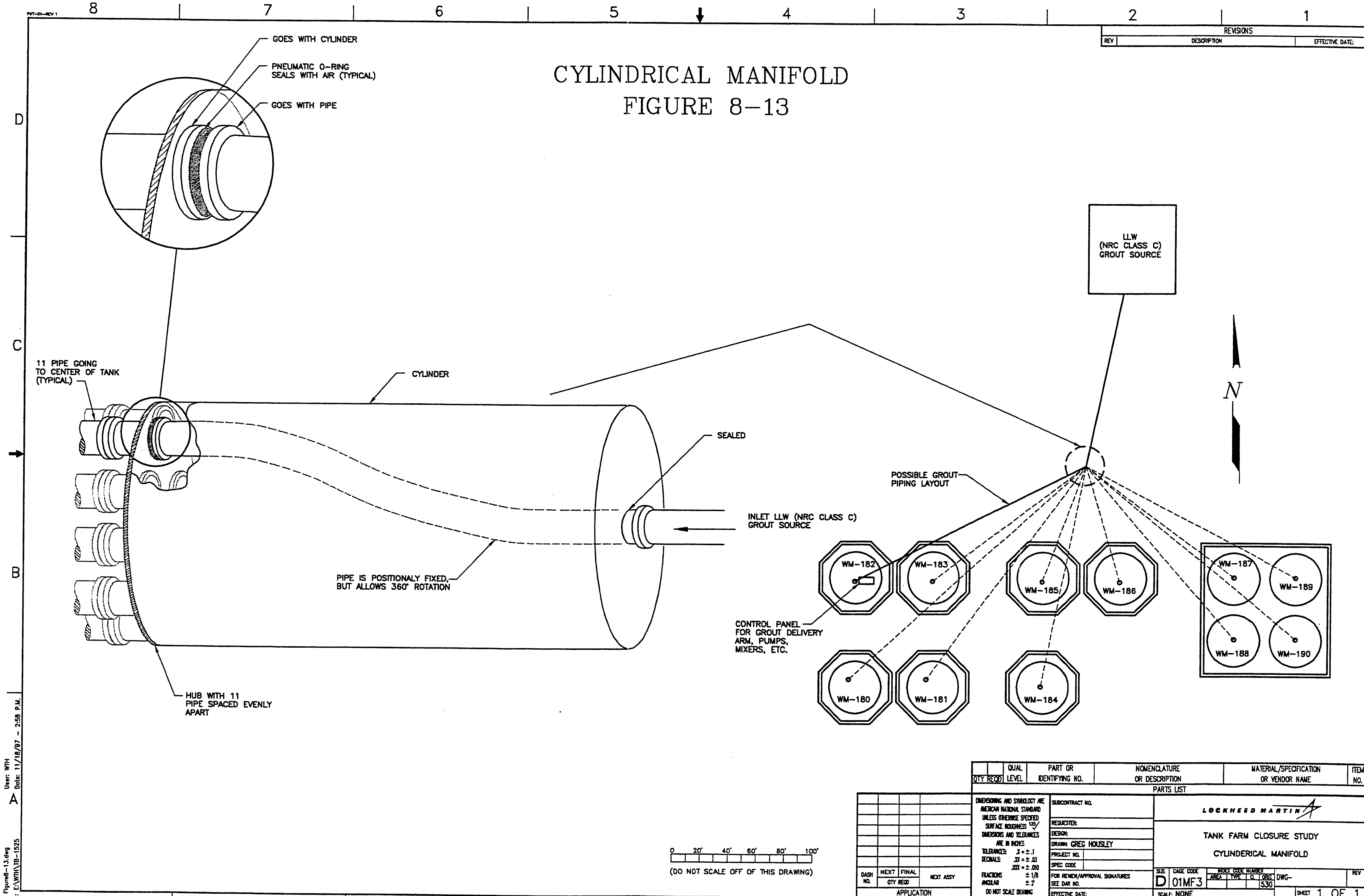
8.4.1.2 Tank Access. The tank void can be accessed either through the tank risers or the manway. The tank riser is a pipe 12 to 18 inches in diameter that leads from the tank to a maximum of 6 feet abovegrade level. There are four to six tank risers connected to each tank. Tank risers usually contain equipment such as transfer pumps, liquid transfer lines, corrosion coupons, and instrumentation lines. This equipment must be removed to allow video, lighting, and void filling material access if not already removed during heel stabilization (Section 8.2). Tank filling will occur through the center most tank riser.

Each vault has a manway through the vault roof located approximately 10 feet belowgrade. Manway use was eliminated for the same reasons described in Section 8.3.1.2. Existing tank risers provide the required access.

8.4.2 Filling Tank Voids with LLW (NRC Class C)

Options 2 and 4 use LLW, NRC Class C type grout to fill the tank void. Filling the void with this material requires creation of an NRC approved landfill. Section 9 discusses NRC landfill creation issues. These issues would require resolution before the TFF could be converted into an NRC landfill.

LLW tank void filling will occur using a manifold arrangement to direct the grout flow (see Figure 8-13). Using a manifold should minimize personnel radiation exposure.



CYLINDRICAL MANIFOLD
FIGURE 8-13

The separations process includes a LLW (NRC Class C) grout plant that will come on line by 2011.[8-17] It is projected that the grouting facility will produce approximately 25,000 m^3 (33,000 yd^3) of NRC Class C grout in 20 years[8-18] or 1,600 yd^3 per year. The concern here is to have enough NRC Class C grout produced to fill tank void spaces in an effective manner. Therefore it is proposed that the Class C grouting facility have the capability to produce enough grout to fill a tank voids with a 2-ft lift every 7 days (approximately 1,600 yd^3/yr) by the year 2024. Actual LLW grout quantities available for tank filling has yet to be resolved.

A tank will be connected to the manifold once that tank is closed to RCRA landfill standards. Class C grout can be emplaced through the center most riser of each tank using the same grout pump design as the clean grout filling pumps but will have to be shielded. Pipelines leading from the tanks will be attached to a cylinder shaped manifold. A single pipeline leading from the NRC Class C grout source will run into the manifold as well. The cylinder will turn and connect the Class C grout source to the individual pipelines leading to a tank void. During a filling run, 2-foot grout lifts will be placed into each of the tank voids. An existing pipeline control-center trailer will be used for control and operations during void filling.

A tank will be filled 2 feet in height then a pig-water-pig arrangement will be used to clean the piping system from the manifold to the tank before switching to the next tank or stopping grout placement. The pigs used to clean the pipe will be left in the tank. The manifold will be switched to the next tank and the cycle would be repeated for each available tank until each tank received a 2-ft grout lift.

8.4.2.1 LLW Fill Material (NRC Class C Grout). The LLW fraction resulting from the separations process will be used for TFF grouting on Options 2 and 4. The grout mixture is a combination of LLW that meets the NRC Class C requirements and clean grout. Waste (up to 25% by volume) is added to clean grout, which results in the final LLW grout waste form. This grout behaves much the same as clean grout (mixing, flowability, etc.). Experimentation is ongoing[8-19] to determine the optimum grout formulation for LLW stabilization where a homogeneous mixture of grout and LLW forms a solidified matrix. NRC requires Class C grout strength to be at least 500 psi.[8-20] Providing this minimum strength helps ensure that the grout will maintain long-term structural integrity.[8-21] NRC Class C grout must have the same attributes as stated in Section 8.3.4.1: pumpable, self-leveling, structural strength, low water permeability, minimal shrinkage, minimize air pockets from forming, and minimal bleed water. Table 8-7 shows a formulation for NRC Class C grout that could be used to fill the tank void[8-22]:

This LLW grout will also require shielding due to its radiation field potential. Table 8-8 provides the estimated Class C grout radiological composition[8-23] that will be placed inside the TFF tanks.

Comparing Table 8.8 to Table 5.1 shows that the Class C grout radiological composition identified for filling the tank void, falls within the lower end of the Class C grout requirement criteria. Shielding requirements will be based on the values shown in Table 8-8. After the pumping process has transpired, Class C grout placement equipment must be washed down, decontaminated or disposed of, and if necessary stored in appropriate storage facility. The NWCF or other decontamination facility will be required to treat the wash down process residues.

Table 8-7. Possible LLW (NRC Class C) grout formulation.

Specific Weight	115	lb/ft^3	
Strength	+3,000	psi	
Formula	28.9	lb/yd^3	Denitrated Waste
	18	lb/yd^3	Portland Cement
	18	lb/yd^3	Blast Furnace Slag
	18	lb/yd^3	Fly Ash
	32.7	lb/yd^3	Water

Table 8-8. Actual radiological composition of class C grout.

	Alumina Calcine[a]	Zirconia Calcine[a]	SBW[b]
Radionuclide	[Ci/m^3]	[Ci/m^3]	[Ci/m^3]
^{3}H	N/A	N/A	N/A
^{63}Ni	N/A	N/A	6.89E-02
^{90}Sr	6.21E+02	5.14E-02	5.20E+01
^{137}Cs	6.79E+02	3.91E-02	5.47E+01
^{14}C	N/A	N/A	N/A
^{99}Tc	3.3E-01	1.16E-01	2.08E-02
^{129}I	N/A	N/A	1.29E-06
^{241}Pu	1.43E-8 [nCi/g]	2.43E-07 [nCi/g]	5.93E-10 [nCi/g]
Alpha-emitting radionuclides with half-lives > 5 years	7.35E-01 [nCi/g]	4.65E+00 [nCi/g]	4.09E-04 [nCi/g]

a. Values shown are estimated decayed activities by 2012.

b. Values shown are activities based on sampling conducted from 11/88 to 2/93

8.4.2.2 Shielding and Contamination Precautions. Pipes carrying Class C grout will be 2 to 4 inches in diameter, double contained and shielded. The actual pipe diameter should be selected to limit radiation fields (by decreasing the volume amount of NRC Class C grout) while still getting acceptable flow rates. Double containment is required to provide leak detection monitoring and lower the risk of a spill.

To minimize radiation exposure, shielding around pipelines will be prefabricated with plate steel or concrete and separated by distance. More information can be found in Section 12.

8.4.2.3 Class C Grout Pipeline Cleanup. Once the 2-foot grout lift is installed inside the tank voids, a pig (i.e., hard rubber ball cartridge) will be pushed through the piping and into the tank void using compressed air. The pig is used to wipe away the residual LLW grout in the pipelines. A pig-water-pig cartridge (see Figure 8-14) will then be pushed through the piping for an added cleansing measure to lower radiation levels. This procedure is intended to clean the pipe sufficiently to reuse again. This prevents cleaning the pipeline with water flushes or other means that may expose personnel to additional radiation. Piping will be able to sit connected until the next grout run. Once the pig has passed through the pipeline into the tank void, the cylindrical manifold will rotate connecting to another pipeline and another tank void will be filled using the same process.

Class C grout pumps, will have to be disconnected from the piping and taken to a decontamination facility for cleaning and decontamination such as the NWCF (if available). An area specifically design to accommodate contaminated equipment will enable the washing of the pumps and other contaminated equipment. Radioactive contaminates will be captured and processed as needed by the NWCF. All equipment that cannot be decontaminated will be disposed of in an approved landfill.

The manifold that connects the grout source to the tank voids will be replaced after each grout run and disposed of in an approved LLW landfill. This will minimize personnel radiation exposure and guarantee an operating manifold.

8.4.2.4 Filling Manifold. The LLW filling manifold will be designed to contain any leakage that may have occurred. The manifold will be disconnected from the piping system and each connection (12 in all) on the manifold will be capped and decontaminated. The manifold will be disposed of in an approved NRC landfill. A new manifold will be installed and tested for operation. Replacing the manifold after each run will minimize the amount of cleaning and cleaning waste generated. A new manifold will minimize any operational issues created from grout that may have leaked into the manifolds cylinder section.

8.4.3 Filling Tank Void with Clean Grout

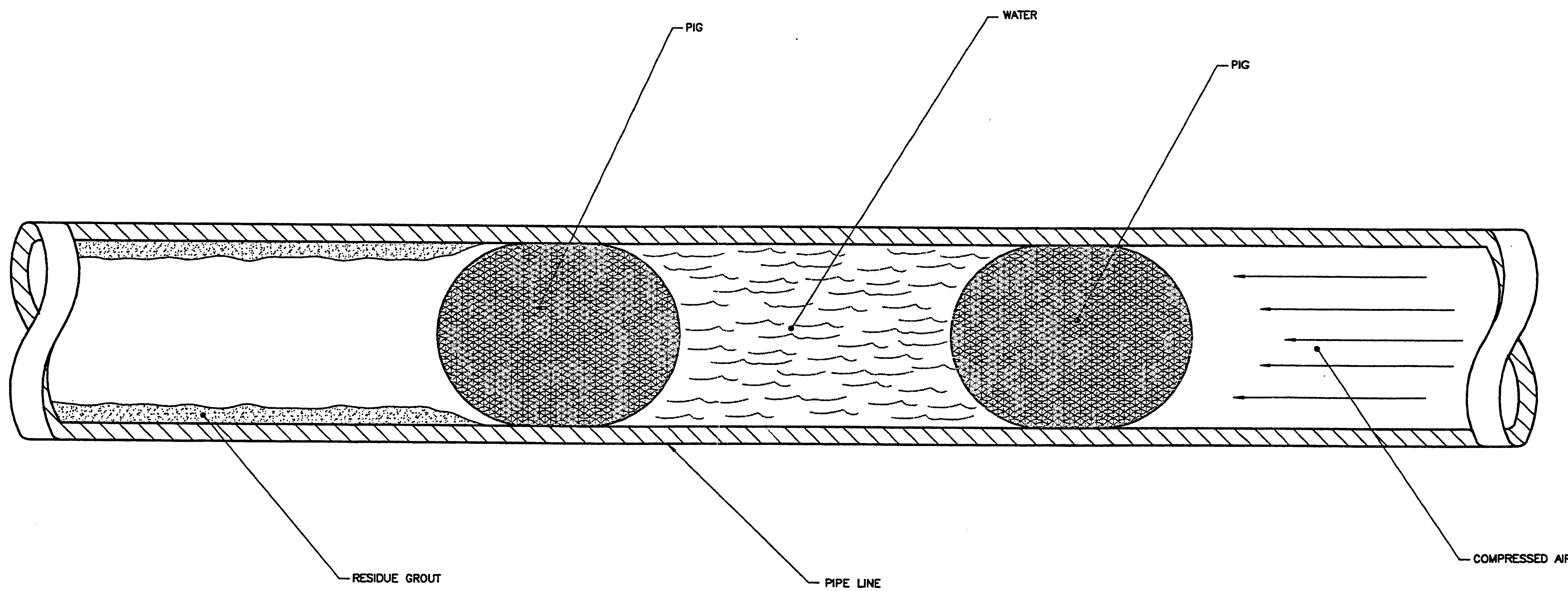
Option 6 uses clean grout to fill the tank void. Clean grout filling is assumed to occur at the same time the vaults are being filled but could be conducted at a later date. This option does not create a landfill after RCRA closure. Worker exposure would be low since the materials used are not contaminated.

Clean grout would be trucked in and pumped into each tank and vault in 2-foot lifts. Clean grout tank void filling is assumed to occur at the same time for all 11 tanks using a manifold arrangement to direct the grout flow as indicated in Figure 8-15. The manifold would be a manual flex pipe connected to the tank being filled. Filling all voids at the same time should provide an environment where a dedicated work force is used. A dedicated work force should minimize potential accidents and minimize the time required for filling.

The first tank and vault would be filled 2 feet in height. A pig would be used to clean the piping system from the manifold to the tank just before switching to the next tank and vault. The pig used to clean the pipe would be left in the tank and vault. The manifold would be switched to the next tank and vault. The cycle would be repeated for each tank and vault until both were filled.

8.4.3.1 Clean Grout Fill Material. Filling the tank void with clean grout will be accomplished using the same type grout used to fill the vault void. Information on clean grout is found in Section 8.3.4.1, "Vault Void Fill Materials."

PIG – WATER – PIG CARTRIDGE
FIGURE 8–14



QTY REQD	QUAL. LEVEL	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.

PARTS LIST

DIMENSIONING AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS 125
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: H HENDRICKS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
PIG–WATER–PIG CARTRIDGE

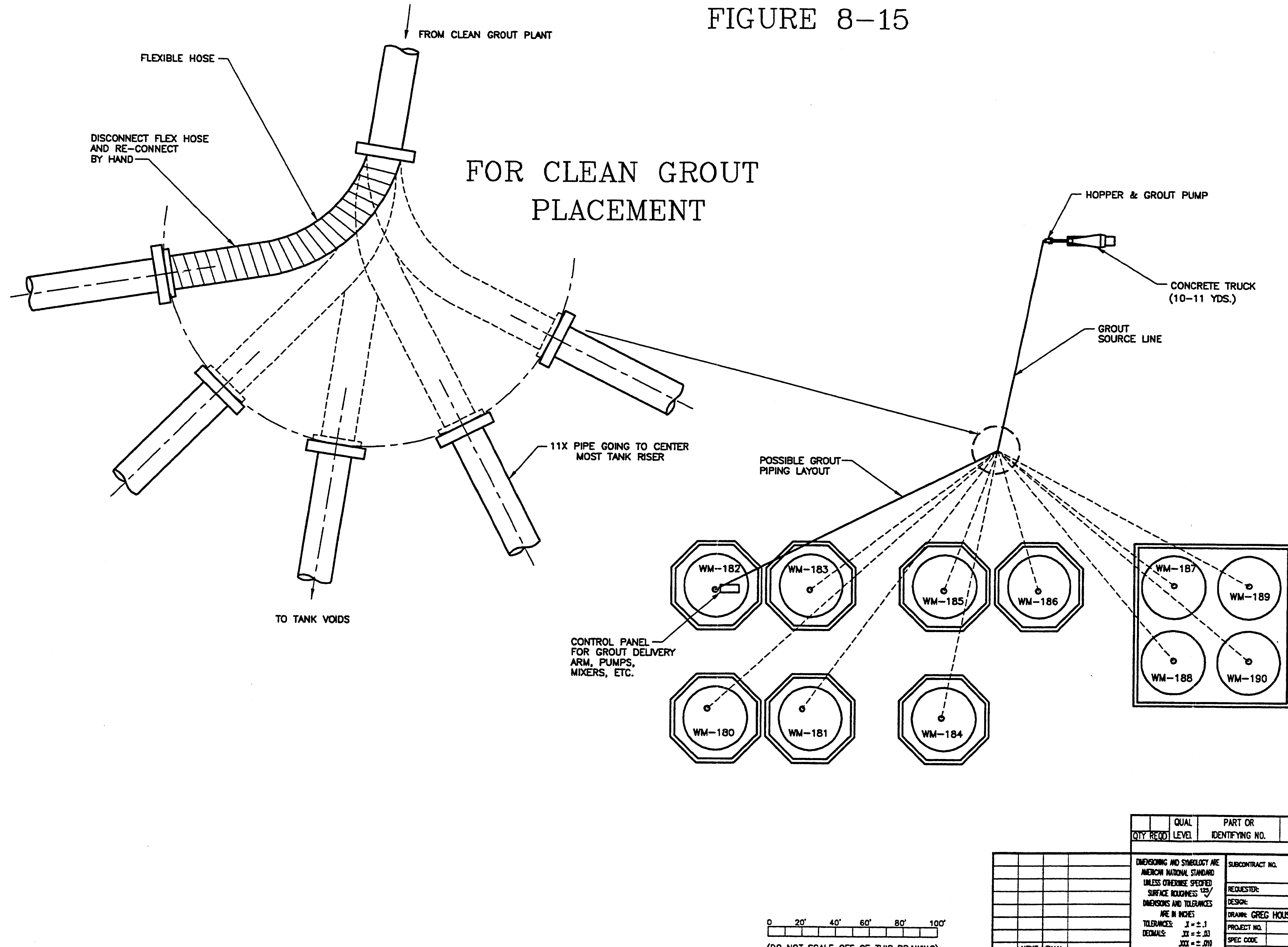
SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER AREA TYPE CL ORIG 530 | DWG– | REV
SCALE: NONE | SHEET 1 OF 1

DASH NO. | NEXT | FINAL | QTY REQD | NEXT ASSY | APPLICATION

REVISIONS: REV | DESCRIPTION | EFFECTIVE DATE:

User: WTH Date: 11/18/97 – 3:04 P.M.
File: Figure8-14.dwg Path: E:\WTH\TB-1525

CLEAN GROUT TANK VOID FILLING PIPING LAYOUT
FIGURE 8-15



LOCKHEED MARTIN

TANK FARM CLOSURE STUDY

CLEAN GROUT TANK VOID FILLING PIPING LAYOUT

DRAWN: GREG HOUSLEY

SIZE D CAGE CODE 01MF3 DWG- 530

SCALE: NONE SHEET 1 OF 1

User: WTH Date: 11/18/97 - 3:11 P.M.

File: Figure8-15.dwg Path: E:\WTH\TB-1525

8.4.4 Filling Tank Void with CERCLA Waste

CERCLA type waste exists in sufficient quantities at the ICPP to fill the tank voids. This filling effort is beyond the scope of this study but costs have been established to allow comparisons between the other two fill materials. Actual CERCLA waste installation would be conducted by CERCLA.

8.4.4.1 CERCLA Fill Material. For purposes of this study, the CERCLA fill material was mixed with paraffin based grout and pumped into the tanks. This method was used based on engineering judgement.

8.5 Conclusions

Closure to RCRA Landfill standards is possible based on the current analysis. Further work must be done to establish the actual closure sequence, materials, and equipment used to accomplish the closure process. The closure and tank void filling processes should be tested on a mocked up tank system to verify proof of principle before actually being used.

Tank Isolation and Heel Stabilization operations must be coordinated to establish the actual isolation sequence of each line. Certain lines are required for use during heel stabilization efforts. Tank Isolation and Heel Stabilization operations must occur soon after (within 2 years) cease use to facilitate closure by 2035. The actual cease use and closure sequence and timing must be defined with the 2035-completion date in mind.

Regulatory issues associated using the TFF for an NRC landfill for NRC Class C type waste must be addressed and resolved before Class C waste placement is possible.

8.6 REFERENCES

8-1. ICPP Tank Farm Planning through 2012, Draft report, W. B. Palmer, September 30, 1997.

8-2. Value Engineering Report, *Summary of the ICPP High-Level Waste Tank Farm Closure Option(s) Selection Using a Value Engineering (VE) Workshop,* JRW-03-97.

8-3. EDF-TFC-001, *CPP Tank Farm Heel Flushing/pH Adjustment*, R. A. Gavalya, May 29, 1997.

8-4. *Tank Farm Heel Removal Project – Conceptual Design Report*, RPT-034; February 3, 1995, ICF Kaiser Engineering.

8-5. *High-Level Waste Tank Farm Replacement Project – Existing Tank Flushing Special Study*, RPT-030; August 1993, ICF Kaiser Engineering.

8-6. EDF-TFC-026, *Tank Heel pH Requirements*, R. A. Gavalya, November 10, 1997.

8-7. EDF-TFC-001, *CPP Tank Farm Heel Flushing/pH Adjustment*, R. A. Gavalya, May 29, 1997.

8-8. EDF-TFC-031, *Flushing Calculations for Scenario A*, January 1998.

8-9. United States Nuclear Regulatory Commission – Low-Level Waste Management Branch Division, "Technical Position on Waste Form", January 1991.

8-10. EDF-TFC-025, *Grout Formula for Tank Heel Displacement*, R. A. Gavalya, January 1997.

8-11. EDF-TFC-003, "Bruce Martin & Tommy Caldwell (SRS Engineers) Phone Interviews, K. D. McAllister, June 27, 1997.

8-12. Lincoln Malik and Said Bolourchi, *Evaluation of existing Vaults for Vehicle Loads, HLWTFR Project*, Advanced Engineering Consultants, Inc., San Francisco, CA, August 1993.

8-13. EDF-TFC-022, *High-Level Waste Tank Concrete Encasement Evaluation*, V. Gorman, October 22, 1997.

8-14. EDF-TFC-024, *Tank Buoyancy Constraints*, K. D. McAllister, November 13, 1997.

8-15. S. A. Jensen P.E., Cell and Tank Grout Testing, Proj. File #015703, EDF #0670, WCF RCRA Closure; Grout Fill, 10/14/97.

8-16. Standard Handbook for Mechanical Engineers (Sixth Edition), Copyright 1967, McGraw-Hill, 07-004122-9: p. 6-231.

8-17. .C. N. Barnes, Estimates of Feed and Wastes Volumes, Compositions and Properties, FFN-ED-01, EDF Serial Number – EDF-FDO-001, 8/21/97, p. 5.

8-18. C. M. Barnes, Estimates of Feed and Waste Volumes, Compositions and Properties, project File Number 73301, Function File Number – ED-01, EDF Serial Number – EDF-FDO-001, 8/21/97..

8-19. FY-97 Status Report on the Low-Activity Waste Grout Stabilization Development Program, AKH-02-97, A. K. Herbst, October 20, 1997.

8-20. United States Nuclear Regulatory Commission – Low-Level Waste Management Branch Division, "Technical Position on Waste Form", January 1991.

8-21. Low-Level Waste Management Branch Division and Low-level Waste Management and Decommissioning, Technical Position on Waste Form Rev. 1, Jan. 1991, p. A-3.

8-22. EDF-TFC-037, *Grout Flow Properties through a 2 to 4 Inch Pipe*, K. D. McAllister, January 26, 1998.

8-23. Charles Barnes, *Estimates of Feed and Waste Volumes, Compositions, and Properties*, Aug. 21, 1997, EDF-FDO-001, Function File Number ED-01.

9. NRC LICENSING OF TANKS FOR LLW DISPOSAL

Regulatory information associated with using the TFF tank voids for LLW disposal is identified in Sections 4 and 5. Because of the preliminary nature of the NRC and DOE negotiations associated with licensing of near-surface LLW disposal areas, it is not possible to predict the impact these future regulations would have on this project. It is noted that the current DOE and NRC radioactive waste disposal regulations are based on the design and construction of new facilities. The TFF, if used for radioactive waste disposal, would be a "retrofit" of an existing mixed waste storage system. This retrofit would require extensive analysis and potential modifications for this new use—disposal. Numerous issues have been identified with the application of the current NRC and DOE requirements to the TFF (see Section 4.7, Regulatory Issues and Concerns). TFF compliance with the new facility design requirements for LLW disposal would require additional analysis and it is anticipated that not all of the "new construction" requirements could be met by the TFF retrofit. Resources would have to be allocated to verify that any deviation or variances from the applicable NRC or DOE requirements are equally health-protective as the original requirement. Retrofit and licensing costs are expected to be high and difficult to predict. Current cost estimates for Options 2 and 4 reflect the best judgement for known conditions. Actual costs may be higher and would be reflected as the design progresses.

10. RADIOLOGICAL PROTECTION AND CONTROLS

Radiological protection is a major concern for any closure activity dealing with mixed waste. Potential release containment and minimizing worker exposures are of the utmost importance. ALARA, which stands for "As Low As Reasonably Achievable," sets the tone for release containment and worker exposure controls. This section identifies the major items with respect to radiological protection and controls for each option developed. Radiological protection and control requirements and assumptions can be found in Section 5.

10.1 General Information

Enclosures will be used on each option to protect the TFF work area from adverse weather conditions and provide lighting and ventilation controls. Option 1 uses a large enclosure to cover the entire TFF (see Section 7.1.3.1) where Options 2 through 6 use two smaller enclosures (see Section 6.4). The single large enclosure could be used for all six options. Further analysis is required to establish the appropriate enclosure configuration for each option.

The enclosure forms a boundary for environmental controls. Separate radiological control tents, Large Area Containment (LAC), will be installed within the enclosure and over the region being accessed. This provides a primary and secondary containment configuration where the LAC is the primary containment structure and the weather enclosure is the secondary containment. This establishes radiological controls as close to the source as possible. Personnel working within an LAC will be required to wear protective clothing and respirators as required to protect the workforce. The actual protective equipment will be selected based on the existing radiological conditions and the specific work to be accomplished. These LACs will have their own HEPA filtered ventilation systems that will exhaust into the main weather enclosure. As the workers exit these LACs, the personal protective equipment will be removed and the personnel surveyed to prevent contamination spread within the main enclosure.

10.1.1 General Option Protection and Controls

High levels of radiation are expected immediately above the riser when the tank risers are open. Personnel involved with working around open risers will be required to remain off to the side to limit their radiation exposure. This will require mockup training for the personnel operating this remote equipment.

All equipment and instrumentation removed from the tanks that have come in contact with the process solution will be sprayed and decontaminated before removal from the riser. These items will be bagged or sealed in sleeving before being removed from the containment tent.

An equipment decontamination containment tent could be constructed on the north end of the TFF to allow immediate equipment decontamination.

Monitoring equipment will be required during the installation, operation, and demobilization of equipment being used for heel removal and D&D activities. The monitoring equipment shall be capable of monitoring alpha and beta radiation in addition to any other monitors deemed necessary by the Safety Analysis Report and cognizant safety professionals.

10.2 Option 1

Option 1 (see Table 2-1) deals with total removal of all TFF items including soils. Personnel exposures will be greater since total removal requires more time and potential sources are exposed during the removal process. Radiological protection and controls specific to this option are discussed below (reference Section 7.1).

10.2.1 Remote Activities

Much of the work required for total removal will require remote removal methods. Remote characterization, excavation, and removal will limit personnel exposures. Various pieces of specialized equipment will be used to reduce the personnel exposure rate.

10.2.2 Paraffin Based Grout

As alpha contamination is expected in the TFF soil matrix, this makes dust control critical since alpha contaminants adhere to soil particles readily, which then become airborne. These microscopic dust particles would spread easily throughout the area of excavation, resulting in added exposure pathways, as well as making decontamination activities much more difficult. For these reasons, contamination control should occur as close to the source as possible. In researching the different methods of contamination control, the only method that actually controls the dust/contamination at its source is in situ stabilization. There are several methods of in situ stabilization - some have not been field tested, and none are known to work in all soil types. It must be assumed that field tests will be conducted at the TFF before jet-grouting any media to control the dust to determine exactly what media should be used.

For the purposes of this study, it is assumed that a paraffin-based grout will be jet-grouted into the excavation pit before any removal activities taking place at the TFF. This grout would then form a first line of defense against the spread of dust.

10.2.3 Waste Packaging

Currently, there are no methods of remote packaging available. A system to remotely package the sections into waste containers would have to be designed, or personnel would be required to do the work. If personnel are required, special consideration must be given to shielding requirements to minimize the exposure levels.

10.2.4 Characterization and Sampling

Geophysical, radiological, chemical, and heavy metal characterization of the site must occur before any remediation/retrieval can take place. This characterization will map the hot spots in the excavation site, as well as any buried obstacles. Geophysical characterization is especially important initially to locate potentially active equipment, such as pipes and power conduits, that do not appear on facility drawings. These maps will be used to determine where remote excavation will be required.

Currently, there are no good data as to the concentration of VOCs contained in the tanks and/or pipes. The only sampling for VOCs that has been done involved steam jetting the air out of the tanks and then sampling for VOCs, thus diluting and/or destroying the results. Because of the toxicity and explosive characteristics of some VOCs, the VOC characterization will be done before any type of excavation activities taking place.

Heavy metal characterization will also be done before initiating any removal activities. The TFF soils have not been characterized for heavy metals in the past, but based on process knowledge, they could be present, and thus heavy metal characterization is warranted.

10.3 Option 2 – Option 6

Options 2 though 6 (reference Table 2-1) are similar in closure methodology. This allows a discussion on radiological protection and controls common to each option. The major difference between the various options is the actual heel concentrations left in a tank. These common radiological protection and controls are addressed below. Tank grouting methods are also addressed below.

10.3.1 Tank Isolation

Lines will be flushed to reduce the radiation fields. Valve boxes should not require shielding after the lines contained within the valve box have been flushed. There should be minimal contamination in each valve box since each valve box was decontaminated during recent system upgrades. Additional personnel protection controls will be added as required.

There will be an exposure issue with any lines that require excavation. There are lines on some tanks that have stubs and others that are spares. These lines may require excavation to access. Exposures are expected to be high unless remote equipment is used. Additional work is required to verify the number and location of each line that would require cleaning.

10.3.2 Characterize Heel Contaminants

Heel sampling will require both liquid and solid material removal from the tank for analysis. Development of this sampling device along with a shielded container to transport this sample to the Remote Analytical Laboratory (RAL) will be needed.

Efforts must be taken to minimize personnel exposure to shine coming through a riser.

10.3.3 Iterative Tank Decontamination

Efforts must be taken to minimize personnel exposure to shine coming through a riser and exposure to heel material removal equipment. The heel material removal equipment will be shielded as required to minimize exposure rates.

10.3.4 Iterative Vault Decontamination

This step is only applicable to Options 2 and 3. Efforts must be taken to minimize personnel exposure to shine coming through a riser and exposure to vault material removal equipment. The vault material removal equipment will be shielded as required to minimize exposure rates. Shielding requirements are expected to be less than that required for tank decontamination work since the vaults are relatively clean when compared to the tank contents.

10.3.5 Characterize Heel Contaminants for Risk Assessment

Same as Section 10.3.2. The actual radiation fields are expected to be lower since much of the contaminant will already be removed.

10.3.5 Characterize Heel Contaminants for Risk Assessment

Same as Section 10.3.2. The actual radiation fields are expected to be lower since much of the contaminant will already be removed.

10.3.6 Grout Heel

Shine through a riser is the only expected exposure point since heel grouting uses clean grout.

10.3.7 Grout Vault

Shine through a riser is the only expected exposure point since vault grouting uses clean grout. The actual exposure rate should be lower since the tank and radiation fields were reduced during tank decontamination efforts and vault contamination is low when compared to the tank.

The exposure rate should be even lower for Options 2 and 3 since the vaults are also decontaminated before grouting.

10.3.8 Tank Void Grouting

There are three materials proposed for filling the tank void.

10.3.8.1 LLW (NRC Class-C Type) Grout. Placing Class C grout will cause high exposure rates along the whole length of the delivery line. Shielding used to reduce the potential exposure impact to personnel could cause a significant weight burden on the designated load zones on the TFF. The size of this grout delivery line and the shielding weight must be minimized to reduce the load zone weight burden while still providing sufficient exposure protection. Excessive personnel exposures can be avoided by restricting access within 100 ft of the grout line during Class-C grouting operations. The Class C grout lines must be flushed before allowing access into this restricted area. Additional shielding will be placed around the proposed manifolds since personnel are expected in this area during normal grouting operations.

Large radius bends must be used on the grout transport line to prevent the formation of Crud Traps where the grout could hang-up and cause high localized radiation fields.

10.3.8.2 CERLCA Type Grout. The same protection controls will be used as those described in Section 10.4.8.2. Actual shielding and distance requirements will be depend on the radiation fields generated by this waste.

10.3.8.3 Clean Grout. There are no significant radiological concerns when using clean grout other than the exposure rates directly above an open riser.

10.4 References

10-1. EDF-TFC-042, "Exposure and Shielding Calculations for Grout Lines," G. C. McCoy, December 17, 1997.

11. COST AND SCHEDULE ESTIMATES

Planning Cost Estimates and Life-Cycle Cost (LCC) Estimates were prepared for six TFF Closure and subsequent use options. The Cost and Life Cycle Estimate data sheets can be found in Volume III of this report. The results of these estimates are presented below.

11.1 Introduction

Planning Cost Estimates are based on permitting costs, direct and indirect costs, construction costs, General and Administrative (G&A) costs, Performance Incentive Fees (PIF), procurement fees, Engineering costs, Inspection costs, Project Management costs, Construction Management costs, escalation, and contingency.

Cost estimates for six TFF Closure and subsequent use options are shown in Table 11-1. The tank void will be filled with LLW, CERCLA soil, or clean grout in all options with the exception of Option 1.

11.2 Planning Cost Estimate Summary

Planning cost estimate summaries were prepared for the six options. The summaries are listed below. Yearly cost spending profiles for each option are attached to the cost estimated contained in Volume III.

11.2.1 Option 1-Closure Activity Cost Estimate Summary

Table 11-2 provides escalated cost estimate breakdown information per major activity for Option 1, while Table 11-3 provides unescalated cost estimate breakdown information. The option schedule can be found in Section 11.3.

Table 11-1. Escalated Cost estimates for TFF Closure Study (in millions).

Option	Name	RCRA Costs	Shared Costs	LLW Costs (NRC Class C)	CERCLA Costs	**Total Project Costs**
1	Total Removal Clean Closure	$3,139.06	$356.63	----	$1,835.77	$5,331.46
2	Risk-Based Clean Closure; LLW Fill	$150.30	----	$33.60	----	$183.90
3	Risk-Based Clean Closure; CERCLA Fill	$153.90	----	----	$56.90	$210.80
4	Close to RCRA Landfill Standards; LLW Fill	$131.80	----	$33.60	----	$165.40
5	Close to RCRA Landfill Standards; CERCLA Fill	$138.00	----	----	$56.90	$194.90
6	Close to RCRA Landfill Standards; Clean Fill	$121.70	----	----	----	$121.70

Table 11-2. Escalated Cost estimate summary for TFF Closure and no subsequent use Option 1 (in millions).

ESCALATED COST ESTIMATE SHARED COST MATRIX

TOTAL REMOVAL CLEAN CLOSURE

ACTIVITY	RCRA COSTS	CERCLA COSTS	SHARED COSTS RCRA	SHARED COSTS CERCLA	TOTAL ACTIVITY COSTS
Permitting and Oversight	$10.10	f			$10.10
Design	$15.70	f			$15.70
Institutional Controls	$7.40	$16.97			$24.37
Treatability Studies	$6.10	$31.53			$37.63
Initial Phased Remedies		$36.50[a]			$36.50
Site Prep – Subcontract	$45.22			$11.78[b]	$57.00
Heel Removal[g]	$517.00				$517.00
Site Prep – LMITCO	$22.20	$65.15	$0.145[c]		$87.49
Soil Stabilization	$411.50				$411.50
Soil Removal and D&D Activities	$1,423.00	$1,252.94	$322.64[d]		2,998.58
Waste Disposal	$289.40	$139.23			$428.63
Post Excavation Activities	$115.94	$293.46		$22.06[e]	$431.46
Debris Cleaning Facility	$224.50				$224.50
LLW Disposal Site	$51.00				$51.00
TOTAL PROJECT COST	**$3,139.06**	**$1,835.77**	**$322.79**	**$33.84**	**$5,331.46**

a. The CERCLA WAG 3 Feasibility Study (FS) estimate included $11.78 million dollars for constructing a weather enclosure.

b. The cost for the WAG 3 FS weather enclosure is considered a shared cost, as only one enclosure would actually be built. This reduces the RCRA enclosure costs by that amount.

c. The WAG 3 FS estimate included $65.29 million dollars for initial and ongoing characterization, sampling, and analysis. The Clean Closure estimate includes $145,300.00 for initial site characterization, which is included here as a cost shared by the RCRA scope and reduces CERCLA costs by that amount. Ongoing characterization costs for the RCRA scope are included in the D&D model and are reflected in the "D&D Activities" cost estimate and are separate and apart from CERCLA costs.

d. See the Total Removal Clean Closure cost estimate, page 3, in Volume III for a breakdown of shared costs.

e. See the Total Removal Clean Closure cost estimate, page 4, in Volume III for a breakdown of shared costs.

f. None Included.

g. The cost associated with processing the waste removed from the tanks during flushing operations is included in the heel removal costs.

Table 11-3. Activity unescalated cost estimate summary for TFF Closure and subsequent use Options 2 through 6 (in millions).

UNESCALATED COST ESTIMATE MATRIX					
ACTIVITY	Option 2	Option 3	Option 4	Option 5	Option 6
Regulatory Compliance	\$12.00	\$12.40	\$12.00	\$11.50	\$2.90
Design	\$18.40	\$19.60	\$17.20	\$18.50	\$13.20
Proof of Process/ORR	\$5.80	\$5.80	\$5.80	\$8.00	\$5.80
Site Preparation	\$9.50	\$9.70	\$9.50	\$9.30	\$9.40
Characterize Heel	\$3.60	\$3.60	\$1.80	\$1.80	\$1.80
Tank Isolation	\$7.70	\$7.70	\$7.70	\$7.70	\$7.70
Wash Interior Tank Walls	\$24.00	\$24.80	\$23.40	\$23.40	\$23.40
Solidify Remaining Heel	\$9.20	\$9.10	\$8.60	\$9.10	\$9.00
Clean Vaults	\$14.00	\$14.00	---	---	---
Fill Vault Voids with Clean Grout	\$8.40	\$8.40	\$13.90	\$13.90	
Fill Tank Void with Class C Grout	\$20.10	---	\$20.10	---	
Fill Tank Void with CERCLA Soil	---	\$27.90	---	\$27.90	
Fill Tank & Vault w/ Clean Grout	---	---	---		\$17.50
TOTAL UNESCALATED PROJECT COST	**\$132.70**	**\$143.00**	**\$120.00**	**\$131.10**	**\$90.70**

11.2.2 Options 2 through 6-Closure Activity Cost Estimate Summary

Table 11-3 provides unescalated comparison cost estimate breakdown information per major activity for TFF Closure Options 2 through 6, while Table 11-4 provides escalated comparison cost estimate breakdown information. The option schedule can be found in Section 11.3.

11.3 Schedule

Option 1 has different schedule activities (see Table 11-5) than Options 2 through 4. Options 2 through 4 have been placed in a separate table for this reason. Schedule Gantt charts reflecting each indicated activity date and duration are attached to the cost estimates contained in Volume III.

Schedule activities for Options 3, 5, and 6 are similar and are shown in Table 11-6.

Scheduled activities for Options 2 and 4 are similar and are shown in Table 11-7.

Table 11-4. Activity escalated cost estimate summary for TFF Closure and subsequent use Options 2 through 6 (in millions).

ESCALATED COST ESTIMATE MATRIX					
ACTIVITY	Option 2	Option 3	Option 4	Option 5	Option 6
Regulatory Compliance	$16.10	$18.10	$15.50	$16.10	$3.70
Design	$20.90	$22.00	$19.50	$20.70	$14.80
Proof of Process/ORR	$6.80	$6.80	$6.80	$9.50	$6.90
Site Preparation	$11.40	$11.40	$11.50	$11.90	$12.20
Characterize Heel	$5.00	$4.60	$2.60	$2.30	$2.30
Tank Isolation	$11.00	$10.20	$11.00	$10.20	$10.20
Wash Interior Tank Walls	$32.50	$33.00	$32.10	$32.50	$31.00
Solidify Remaining Heel	$12.00	$12.40	$11.00	$12.40	$12.40
Clean Vaults	$21.40	$21.90	---	---	---
Fill Vault Voids with Clean Grout	$13.20	$13.50	$21.80	$22.40	
Fill Tank Void with Class-C Grout	$33.60	---	$33.60	---	
Fill Tank Void with CERCLA Soil	---	$56.90	---	$56.90	
Fill Tank & Vault w/ Clean Grout	---	---	---		$28.20
TOTAL PROJECT COST	**$183.90**	**$210.80**	**$165.40**	**$194.90**	**$121.70**

Table 11-5. Proposal Schedule for TFF Closure and no subsequent use Option 1.

Activity	Timeframe
Process Development	2004 – 2007
Closure Plan	2007 – 2009
Treatability Studies	2008 – 2010
Site Prep. – Subcontract	2010 – 2013
Provide Operational Debris Cleaning Facility	2023 – 2029
Provide LLW Disposal Site	2023 – 2029
Heel Removal	2011 – 2025
Site Prep. – LMITCO	2025
Soil Stabilization	2025 – 2029
D&D	2027 – 2034
Waste Disposal	2028 – 2034
Postexcavation	2035 – 2037

Table 11-6. Proposal Schedule for TFF Closure and subsequent use Options 3, 5, and 6.

Function	Option 3	Option 5	Option 6
Design	2000 to 2005	2000 – 2005	2000 – 2005
Solidify Heel	2005 to 2018	2005 - 2018	2005 - 2018
Fill Vault Voids with Clean Grout WM-182 – WM-186	2013 to 2014	2013 – 2014	2013 – 2014
Fill Vault Voids with Clean Grout Remaining Tanks	2020 to 2021	2020 – 2021	2020 – 2021
Fill Tank Voids with Clean Grout WM-182 – WM-186	---	---	2013 – 2014
Fill Tank Voids with Clean Grout Remaining Tanks	---	---	2020 – 2021
Fill Tank Voids with CERCLA Soil	2022 – 2029	2022 – 2029	---
Fill Tank Void with LLW	---	---	---

Table 11-7. Proposed Schedule for TFF Closure and Subsequent Use[a] Options 2 and 4.

Function	Option 2	Option 4
Design	2000 to 2005	2000 to 2005
Close WM-182 and WM-186	2007 to 2011	2007 to 2011
Fill Tank Voids with LLW	2011 to 2013	2011 to 2013
Close WM-184	2007 to 2011	2007 to 2011
Fill Tank Void with LLW	2013 to 2014	2013 to 2014
Close WM-186	2010 to 2013	2010 to 2013
Fill Tank Void with LLW	2014 to 2015	2014 to 2015
Close WM-185	2011 to 2014	2011 to 2014
Fill Tank Void with LLW	2015 to 2016	2015 to 2016
Close WM-180	2012 to 2015	2012 to 2015
Fill Tank Void with LLW	2016 to 2017	2016 to 2017
Close WM-181	2014 to 2017	2014 to 2017
Fill Tank Void with LLW	2017 to 2018	2017 to 2018
Close WM-187 and WM-188	2014 to 2019	2014 to 2019
Fill Tank Voids with LLW	2018 to 2022	2018 to 2022
Close WM-189 and WM-190	2016 to 2021	2016 to 2021
Fill Tank Voids with LLW	2020 to 2024	2020 to 2024

a. Actual subsequent use (LLW filling) schedule must be coordinated with the CSSF subsequent use (LLW filling) schedule.

11.4 Life-Cycle Costs

Life-Cycle Cost estimates are based on initial development, construction, operating, and postoperating costs over an assumed operating life. The cost and schedule information defined in the previous tables were used to define the life-cycle costs are found in Table 11-8. Table 11-8 provides the LCC summary information. The life cycle cost data sheets can be found in Volume III.

11.4.1 Life Cycle Cost Methodology

The Economic Evaluation assumed a maximum 35-year period, (2003–2036) since this is the estimated time required to complete all of the anticipated remediation activities. If monitoring will be required after closure, the analysis assumed CERCLA would provide this service at no cost. The LCC is identified for each alternative by evaluating the initial development, construction, operating and post operating costs over the life-cycle. A discounted LCC analysis assumes a current dollar basis, discounted to 1998 using a 6.30% annual discount rate per the Office of Management and Budget (OMB) Circular A-94. All costs are conservatively discounted assuming the end-of-year convention.

11.4.2 Assumptions

The scope of work and requirements of all related activities are vague at this time. Facility and processing costs are typically taken from reference cost estimates of similar scope; however, projects of this magnitude are not available. All costs are assumed to be reasonable for the purposes of the estimate and reflect historical experience associated with D&D work at the INEEL.

The LCC analysis has been generated to match the division provided by cost estimating. These costs include Permitting, Direct and Indirect Construction, G&A, Performance Incentive Fee (PIF), Procurement fee, Engineering, Inspection, Project Management, Construction Management, Escalation and Contingency costs.

Table 11-8. Total Life cycle cost summary for TFF Closure Options 1 through 6 (in millions).

Totals	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
TECC[a] (Unescalated)	h	$97.580	$104.536	$88.136	$95.282	$66.681
TECC Plus[b, g]	$5,331.456	$183.900	$210.800	$165.400	$194.900	$121.700
POG[c] (Unescalated)	N/A	$7.806	$8.363	$7.051	$7.623	$5.335
POG Plus[d]	N/A	$21.613	$26.959	$20.081	$24.229	$13.255
CLCC[e] (Unescalated)	h	$105.386	$112.899	$95.187	$102.904	$72.016
CLCC Plus[b]	$5,331.456	$205.513	$237.760	$185.481	$219.129	$134.925
CLCC Discounted[b, f]	**$985.329**	**$91.239**	**$98.238**	**$82.380**	**$91.310**	**$64.782**

a. Total Estimated Closure Cost
b. Total includes escalation, management reserve, and contingency.
c. Post Operations to Greenfield
d. Total includes escalation and contingency.
e. Cumulative Life Cycle Cost
f. Reported in 1998 discounted dollars.
g. Summary value shown on the cost estimates.
h. RCRA unescalated costs are $1044.194. No unescalated costs for the CERCLA portion of the cost estimate were available.

Option 1 assumes the project will provide total removal of heels, tanks, and vaults with soils being removed to a depth of 50 feet. All utilities will be removed. The entire area will be backfilled and compacted following demolition.

Option 1 will not require CERCLA monitoring after closure activities because all contaminants have been removed to nondetectable levels. Options 2 through 6 will be turned over to CERCLA for monitoring after completion because contaminates will remain on the site.

Options 2 through 6 use various methods for closure where some residual contamination will remain. Options 2 and 3 assume Risked Based Clean Closure with either LLW or CERCLA fill. Options 4, 5, and 6 assume closure to RCRA Landfill Standards with either LLW, CERCLA, or Clean fill. Options 2 through 6 assumes a decommissioning cost equal to 2% of closure activities (unescalated) cost, decontamination costs equal to 5% of closure activities (unescalated) cost, and demolition costs equal to 1% of closure activities (unescalated) cost. Option 1 assumed closure without D&D costs due to the area would be inherently returned the site to a green-field status.

11.5 Work Scope and Assumptions

The following sections contain the scope of work and assumptions that were used as the basis for the cost estimates. Estimate references are contained in the appropriate cost estimate. Refer to the cost estimates in Volume III for any clarification.

11.5.1 Option 1—Total Removal Clean Closure

11.5.1.1 Project Work Scope. This cost estimate is based on the following work scope as quoted from the TRCC cost estimate contained in Volume III of this report:

"This project will provide clean closure for the ICPP Tank Farm Area. Tank heels will be removed from the 11 waste storage tanks, WM-180 to –190, and tank interiors will be sprayed to remove solid contamination. Soil will be removed to a depth of 50 feet, and yard utilities will be removed. Eight existing concrete tank vaults, CPP-780 to CPP-786, and the waste tanks will be demolished and removed. The entire area will be backfilled and compacted following demolition and removal."

11.5.1.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost.

1. Since the scope of work and requirements for many related activities are vaguely defined at this time, costs for facilities and processes are typically taken from the referenced cost estimates, which reflect projects assumed to be similar in nature and scope. It is assumed that the references and cost allowances noted in the estimates provide reasonable bases upon which to develop the estimates, and that the resulting costs are appropriate to the order of magnitude intended.

2. It is assumed that all demolition, soil removal, and related operations will be accomplished by LMITCO Force Account or operations personnel, and that all clean backfill, new construction work, and soil grouting will be competitively bid and performed by a general contractor as the prime subcontractor, with specialty lower tier subcontractors as appropriate. It is also assumed that nonworking supervision will be required.

3. Construction related costs for the heel removal effort are taken from Appendix A, Reference a, and are assumed to include all costs necessary to accomplish the work including, but not necessarily limited to, site preparation, installation and removal of all supporting equipment and utilities, packaging and removal of waste products, decontamination and cleanup, mobilization and demobilization, and cost of supporting organizations.

4. The labor hours shown in Reference a have been incorporated; however, current Force Account rates have been used, which generally differ from the rates shown in the reference, and it has further been assumed that current labor burden adders equate to, and account for, the Subcontract Overhead and Profit (SCOHP) and Other Direct Costs (ODC) costs included in the estimate.

5. Reference b addresses the removal of the soil from the TFF; it is assumed that all work listed in Reference b will take place under CERCLA provisions, while all work addressed in this estimate will take place under RCRA provisions. It is further assumed that the enclosures and teleoperated cranes listed herein will accommodate the CERCLA activities and will supersede those items shown in the reference.

6. Reference b of the cost estimate includes costs for the following activities. Where costs for these activities have been shown, they have been assumed to be required over and above those shown in the reference:

   a. FFA/CO management and oversight, and remedial action/remedial design (RA/RD) documentation; additional costs assumed.

   b. Treatability studies. The reference includes studies for stabilization grout mixture and the assay system. This estimate includes assumed costs for the foundation wall grout and paraffin-based grout matrix stabilization.

   c. Initial Phased Remedies (IPRs). As required by the FS; include Phase I, Surface Water Drainage Modifications; Phase II, Weatherproof Enclosure; Phase III, Vertical Barriers (Slurry Wall). Costs not included herein.

   d. Site characterization. Additional site characterization costs are included as shown.

   e. Treatment Enclosure and utilities. The reference includes costs for facility utilities and for a 179,000 ft^2 primary containment enclosure and a 240,000 ft^2 secondary containment enclosure. This estimate changes those enclosures to a 40,000 ft^2 primary and 52,900 ft^2 secondary enclosure and retains the utilities and supporting facilities. An additional 125,000 ft^2 engineered metal weather enclosure is also included; costs for the weather enclosure are based on historical costs for the Transuranic Storage Area (TSA) Retrieval Enclosure (RE).

   f. Excavation. The reference includes all costs relating to excavation, treatment, packaging, and shipment of soils, including equipment, labor, and utilities. This work is assumed to be accomplished under CERCLA provisions, and no additional costs are included herein.

g. Decontamination facilities. The reference includes a 14 x 70-foot personnel decontamination trailer and a 40 x 75-foot portable equipment decontamination structure. Costs for an additional portable decontamination station are included herein.

h. Interim Storage and Loading Facilities. A 50 x 100-foot Interim Storage Facility and 50 x 80-foot Loading Facility are included. Costs allowances have been included in the estimate entitled "D&D Activities" for modifications to the Loading Facility to accommodate shipping casks required by the RCRA scope.

i. Shipping Support Facility. An 80 x 100-foot Shipping Support Facility is included.

j. Analytical Laboratory Facility. The reference assumes that an Analytical Laboratory Facility will be required. No additional costs have been included.

k. Tank Farm soils disposal pit and cap. Costs for these items have not been included.

l. Operations and maintenance labor and material, utilities waste transportation and acceptance, and D&D costs are included in the reference for soil removal. Additional costs have been included herein for postexcavation activities.

m. The reference includes costs for surveillance and monitoring that have not been included in this estimate. Additional costs have been included herein for postexcavation activities.

7. Engineering, design, inspection, construction management, and project management will be performed in-house.

8. Costs for ED&I, project management, and construction management have typically been applied as a percentage of construction costs, based on historical experience at the INEEL, and may vary depending upon the assumed scope and complexity of the work. Costs are assumed to be reasonably accurate for the purposes of the estimate.

9. It is assumed that minimal site preparation will be required. An allowance has been included for additional service and access roads as appropriate.

10. Separate permitting costs have been included for the TFF work, for the proposed DTF, and LLW Disposal Site. The estimated permitting costs are assumed to encompass those activities required.

11. Reference i reflects historical cost experience associated with D&D work at the INEEL. Costs are complete costs and include project and construction management; characterization; documentation; work permits; supervision, labor, equipment, and material; mobilize and demobilize; supporting organizations; and packaging and disposal costs. Costs are typically derived from demolition of buildings and structures and incorporate rating factors that account for the hazardous and radiological environment anticipated; an additional, productivity factor has been applied to reflect remote working conditions.

12. The D&D model calculates waste stream volumes that have been typically experienced. Unless otherwise given in the references, these volumes have been assumed to be appropriate. Assumed waste classifications are as provided in EDF-TFC-015.

13. It is recognized that the specific job site conditions may vary somewhat from the historical conditions upon which the D&D model is based, but it is felt that the model provides sufficiently accurate data for the purposes of the estimate. Copies of the D&D model are included as attachments to the appropriate activity cost estimates.

14. It is assumed that any imported soils will come from within the confines of the INEEL, that no soils will need to be imported from offsite, and that source pit restoration will be required.

15. The number of casks for transporting waste onsite is assumed to be five.

16. The estimate assumes the need for a new DTF and a new Low-Level Waste Disposal Site. The proposed facilities are assumed to be similar in scope to the facilities costed in the references shown; however, the LLW Disposal Site is assumed to be approximately 60% of the scope of the referenced facility, and the resultant costs are assumed to be appropriate. It is further assumed that the facilities will be located on the INEEL.

17. The documentation costs shown for the LLW Disposal Site are taken from Reference e and, per that reference, are assumed to represent all activities required for a RCRA Subtitle D compliant facility.

18. The proposed schedule calls for heel removal to take place 2013 through 2025, and excavation and D&D work from 2025 through 2035. Based on this schedule, the following activity midpoints have been established for purposes of calculating escalation:

    a. Permitting and Oversight: 2016, midpoint between now and 2035.

    b. Process Development: 2005, 3 years before Treatability Studies.

    c. Institutional Controls: 2016, midpoint between now and 2035.

    d. Treatability Studies: 2008, 1 year before heel removal design.

    e. Site Prep/Subcontract: 2011, 2 years before heel removal.

    f. Heel Removal: 2019, midpoint of activity.

    g. Site Prep/LMITCO: 2026, following heel removal.

    h. Soil Stabilization: 2026, following heel removal.

    i. D&D Activities: 2026, for completion before start of D&D.

    j. Waste Disposal: 2026, for completion before start of D&D.

    k. Postexcavation Activities: 2035, following D&D.

l. Debris Cleaning Facility: 2016, midpoint between now and 2035.

m. LLW Disposal Site: 2016, midpoint between now and 2035.

19. It is assumed that TFF perimeter shoring will be placed for excavation purposes, left in place, and removed during backfill operations.

20. Reference h for general project assumptions that may be relevant to the cost estimate.

11.5.2 Option 2—Risk-Based Clean Closure; LLW Fill

11.5.2.1 Project Work Scope. This cost estimate is based on the following work scope as quoted in the Option 2, RBCC; LLW Fill estimate contained in Volume III of this report:

"This project will provide RCRA closure for the eleven waste storage tanks at the ICPP. The tank heels will be flushed and neutralized. Tank internals will be sprayed to remove solid contamination. The remaining heel will be stabilized with grout. The vaults will be filled with clean grout. The tank voids will be filled with Class-C grout. Finally, the tank farm will be turned over to CERCLA to monitor."

11.5.2.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost. For any clarification refer to the cost estimate in Volume III.

NOTE: Assumptions 18, 22, and 25 were updated to reflect the current cost estimate criteria used. These three assumptions were not corrected to reflect the final closure methodology presented within this report.

1. All of the field work will be accomplished by Force Account personnel or operations personnel. LMITCO personnel will design, manage, and acquire permits.

2. This estimate is intended to cover project costs from project authorization to turnover. No distinction was made for "color of money."

3. The percentages used for Design, Inspection and, to some extent, Construction Management are slightly lower than those regularly used on an effort of this size. Much of the closure involves repetitive work after filling the first tank.

4. Project Management will maintain a fairly high level of involvement throughout the closure period.

5. The proposed schedule is:

Design -	2000 to 2005
Solidify Heel -	2007 to 2019
Fill Vault Voids with Clean Grout:	
WM-182 – WM-186 -	2010 to 2014
Remaining Tanks -	2015 to 2021
Fill Tank Voids with Class C Grout:	2011 to 2024.

6. Temporary construction facilities cover craft change and lunch areas, offices, and warehousing.

7. Permitting assumptions: Others will accomplish the Environmental Impact Statement (EIS). An Environmental Assessment (EA) will not be required in addition to the EIS. Delisting of hazards is by others. Postclosure monitoring is CERCLA's responsibility.

8. All excavated soil can be reused as backfill within the TFF.

9. Excavation incorporates shoring to minimize exposure to contaminated dirt.

10. Much of the productivity was based on actual costs incurred on the TFF Upgrades Project.

11. The 'Tank Farm Heel Removal Project' conceptual draft estimate, dated 12/19/94, was used as a reference.

12. Heel and vault grout costs are based on the "sand" grout used in the WCF Deactivation Project.

13. Grout drop tubes can be decontaminated and reused as needed.

14. Grout placement unit labor hours include time for setup and cleaning of grout equipment after each pour.

15. Heel characterization costs represent three sets of samples for each tank.

16. Heel flushing and riser equipment removal costs were confirmed with Dave Machovec.

17. Mounting/support frames were assumed for each piece of riser equipment to distribute their weight as well as to provide a mounting base.

18. Was: The TFF area enclosure is sized to cover all tanks at once with traffic lanes around the perimeter.

    Now: The TFF area enclosure is sized to cover two tanks at once with traffic lanes around the perimeter.

19. Heel transfer lines will require shielding from the tanks to the appropriate valve box tie-in.

20. The clean grout pump will be staged north of Tanks 185 and 186.

21. Spare equipment was estimated where needed.

22. Was: All 11 tank heels will be solidified before Class C grout pours begin.

    Now: Each tank heel will be solidified separately followed by filling with Class C grout.

23. Shielded grout delivery lines will be run from the Class C grout source to each tank. All lines will remain in place during the entire grout sequence. They will be cleaned between pours.

24. The valve/manifold will be a self-contained unit that will minimize potential radioactive releases and contamination.

25. Was: The required amount of Class C grout to fill all 11 tanks 2 feet at a time can be produced in the 11-day period discussed in the report.

    Now: The required amount of Class C grout to fill all 1 tank 2 feet at a time can be produced when required.

11.5.3 Option 3—Risk-Based Clean Closure; CERCLA Fill

11.5.3.1 Project Work Scope. This cost estimate is based on the following work scope as quoted from Volume III of this report:

"This project will provide RCRA closure for the eleven waste storage tanks at the ICPP. The tank heels will be flushed and neutralized. Tank internals will be sprayed to remove solid contamination. The remaining heel will be stabilized with grout. The vaults will be filled with clean grout. The tank voids will be filled with CERCLA soil. Finally, the tank farm will be turned over to CERCLA to monitor."

11.5.3.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost.

1. All of the field work will be accomplished by Force Account personnel or operations personnel. LMITCO personnel will design, manage, and acquire permits.

2. This estimate is intended to cover project costs from project authorization to turnover. No distinction was made for "color of money."

3. The percentages used for Design, Inspection and, to some extent, Construction Management are slightly lower than those regularly used on an effort of this size. Much of the closure involves repetitive work after filling the first tank.

4. Project Management will maintain a fairly high level of involvement throughout the closure period.

5. The proposed schedule is:

Design -	2000 to 2005
Solidify Heel -	2005 to 2018
Fill Vault Voids with Clean Grout:	
WM-182 – WM-186 -	2013 to 2014
Remaining Tanks -	2020 to 2021
Fill Tank Voids with Class-C Grout:	2022 to 2029.

6. Temporary construction facilities cover craft change and lunch areas, offices, and warehousing.

7. Permitting assumptions: Others will accomplish the EIS. An EA will not be required in addition to the EIS. Delisting of hazards is by others. Postclosure monitoring is CERCLA's responsibility.

8. All excavated soil can be reused as backfill within the TFF.

9. Excavation incorporates shoring to minimize exposure to contaminated dirt.

10. Much of the productivity was based on actual costs incurred on the Tank Farm Upgrades Project.

11. The 'Tank Farm Heel Removal Project' conceptual draft estimate, dated 12/19/94, was used as a reference.

12. Heel and vault grout costs are based on the "sand" grout used in the WCF Deactivation Project.

13. Grout drop tubes can be decontaminated and reused as needed.

14. Grout placement unit labor hours include time for setup and cleaning of grout equipment after each pour.

15. Heel characterization costs represent three sets of samples for each tank.

16. Heel flushing and riser equipment removal costs were confirmed with Dave Machovec.

17. Mounting/support frames were assumed for each piece of riser equipment to distribute their weight as well as to provide a mounting base.

18. The TFF area enclosure is sized to cover all tanks at once with traffic lanes around the perimeter.

19. Heel transfer lines will require shielding from the tanks to the appropriate valve box tie-in.

20. The clean grout pump will be staged north of Tanks 185 and 186.

21. Spare equipment was estimated where needed.

22. All 11-tank heels will be solidified before CERCLA soil placement begins.

23. Others will deliver the CERCLA soil to the TFF containment.

24. The CERCLA soil will be mixed with a paraffin-based grout, in a facility located within the containment structure, to reduce contaminated dust.

25. A double-contained, shielded screw conveyor will be used to transport the CERCLA soil/paraffin-based grout mixture to one tank at a time. The tanks are assumed to hold approximately 13,500 yd^3 of soil (actual volume is about 18,000 yd^3).

11.5.4 Option 4—Close to RCRA Landfill Standards; LLW Fill

11.5.4.1 Work Scope. This cost estimate is based on the following work scope as quoted from Volume III of this report:

"This project will provide RCRA closure for the eleven waste storage tanks at the ICPP. The tank heels will be flushed and neutralized. Tank internals will be sprayed to remove solid contamination. The remaining heel will be stabilized with grout. The vaults will be filled with clean grout. The tank voids will be filled with Class C grout. Finally, the tank farm will be turned over to CERCLA to monitor."

NOTE: Assumptions 18, 22, and 25 were updated to reflect the current cost estimate criteria used. These three assumptions were not corrected to reflect the final closure methodology presented within this report.

11.5.4.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost.

NOTE: Assumptions 18, 22, and 25 were updated to reflect the current cost estimate criteria used. These three assumptions were not corrected to reflect the final closure methodology presented within this report.

1. All of the field work will be accomplished by Force Account personnel or operations personnel. LMITCO personnel will design, manage, and acquire permits.

2. This estimate is intended to cover project costs from project authorization to turnover. No distinction was made for "color of money."

3. The percentages used for Design, Inspection and, to some extent, Construction Management are slightly lower than those regularly used on an effort of this size. Much of the closure involves repetitive work after filling the first tank with grout.

4. Project Management will maintain a fairly high level of involvement throughout the closure period.

5. The proposed schedule is:

Design -	2000 to 2005
Solidify Heel -	2007 to 2019
Fill Vault Voids with Clean Grout:	
WM-182 – WM-186	2010 to 2014
Remaining Tanks	2015 to 2021
Fill Tank Voids with Class C Grout	2011 to 2024.

6. Temporary construction facilities cover craft change and lunch areas, offices, and warehousing.

7. Permitting assumptions: Others will accomplish the EIS. An EA will not be required in addition to the EIS. Delisting of hazards is by others. Postclosure monitoring is CERCLA's responsibility.

8. All excavated soil can be reused as backfill within the TFF.

9. Excavation incorporates shoring to minimize exposure to contaminated dirt.

10. Much of the productivity was based on actual costs incurred on the Tank Farm Upgrades Project.

11. The 'Tank Farm Heel Removal Project is conceptual draft estimate, dated 12/19/94, was used as a reference.

12. Heel and vault grout costs are based on the "sand" grout used in the WCF Deactivation Project.

13. Grout drop tubes can be decontaminated and reused as needed.

14. Grout placement unit labor hours include time for setup and cleaning of grout equipment after each pour.

15. Heel characterization costs represent three sets of samples for each tank.

16. Heel flushing and riser equipment removal costs were confirmed with Dave Machovec.

17. Mounting/support frames were assumed for each piece of riser equipment to distribute their weight as well as to provide a mounting base.

18. Was: The TFF area enclosure is sized to cover all tanks at once with traffic lanes around the perimeter.

    Now: The TFF area enclosure is sized to cover two tanks at once with traffic lanes around the perimeter.

19. Heel transfer lines will require shielding from the tanks to the appropriate valve box tie-in.

20. The clean grout pump will be staged north of Tanks 185 and 186.

21. Spare equipment was estimated where needed.

22. Was: All 11 tank heels will be solidified before Class C grout pours begin.

    Now: Each tank heel will be solidified separately followed by filling with Class C grout.

23. Shielded grout delivery lines will be run from the Class C grout source to each tank. All lines will remain in place during the entire grout sequence. They will be cleaned between pours.

24. The valve/manifold will be a self-contained unit that will minimize potential radioactive releases and contamination.

25. Was: The required amount of Class C grout to fill all 11 tanks 2 feet at a time can be produced in the 11-day period discussed in the report.

Now: The required amount of Class C grout to fill all 1 tank 2 feet at a time can be produced when required.

11.5.5 Option 5—Close to RCRA Landfill Standards; CERCLA Fill

11.5.5.1 Work Scope. This cost estimate is based on the following work scope as quoted from Volume III of this report:

"This project will provide RCRA closure for the eleven waste storage tanks at the ICPP. The tank heels will be flushed and neutralized. Tank internals will be sprayed to remove solid contamination. The remaining heel will be stabilized with grout. The vaults will be filled with clean grout. The tank voids will be filled with CERCLA soil. Finally, the tank farm will be turned over to CERCLA to monitor."

11.5.5.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost.

1. All of the fieldwork will be accomplished by Force Account personnel or operations personnel. LMITCO personnel will design, manage, and acquire permits.

2. This estimate is intended to cover project costs from project authorization to turnover. No distinction was made for "color of money."

3. The percentages used for Design, Inspection and, to some extent, Construction Management are slightly lower than those regularly used on an effort of this size. Much of the closure involves repetitive work after filling the first tank with grout.

4. Project Management will maintain a fairly high level of involvement throughout the closure period.

5. The proposed schedule is:

Design -	2000 to 2005
Solidify Heel -	2005 to 2018
Fill Vault Voids with Clean Grout:	
WM-182 – WM-186 -	2013 to 2014
Remaining Tanks -	2020 to 2021
Fill Tank Voids with CERCLA Soil:	2022 to 2029.

6. Temporary construction facilities cover craft change and lunch areas, offices, and warehousing.

7. Permitting assumptions: Others will accomplish the EIS. An EA will not be required in addition to the EIS. Delisting of hazards is by others. Postclosure monitoring is CERCLA's responsibility.

8. All excavated soil can be reused as backfill within the TFF.

9. Excavation incorporates shoring to minimize exposure to contaminated dirt.

10. Much of the productivity was based on actual costs incurred on the Tank Farm Upgrades Project.

11. The 'Tank Farm Heel Removal Project' conceptual draft estimate, dated 12/19/94, was used as a reference.

12. Heel and vault grout costs are based on the "sand" grout used in the WCF Deactivation Project.

13. Grout drop tubes can be decontaminated and reused as needed.

14. Grout placement unit labor hours include time for setup and cleaning of grout equipment after each pour.

15. Heel characterization costs represent three sets of samples for each tank.

16. Heel flushing and riser equipment removal costs were confirmed with Dave Machovec.

17. Mounting/support frames were assumed for each piece of riser equipment to distribute their weight as well as to provide a mounting base.

18. The TFF area enclosure is sized to cover as many as four tanks at once with traffic lanes around the perimeter.

19. Heel transfer lines will require shielding from the tanks to the appropriate valve box tie-in.

20. The clean grout pump will be staged north of Tanks 185 & 186.

21. Spare equipment was estimated where needed.

22. All 11 tank heels will be solidified before CERCLA soil placement begins.

23. Others will deliver the CERCLA soil to the TFF containment.

24. The CERCLA soil will be mixed with a paraffin-based grout, in a facility located within the containment structure, to reduce contaminated dust.

25. A double-contained, shielded screw conveyor will be used to transport the CERCLA Soil/paraffin-based grout mixture to one tank at a time. The tanks are assumed to hold approximately 13,500 yd^3 of soil (actual volume is about 18,000 yd^3).

11.5.6 Option 6—Close to RCRA Landfill Standards; Clean Fill

11.5.6.1 Work Scope. This cost estimate is based on the following work scope as quoted from Volume III of this report:

"This project will provide RCRA closure for the eleven waste storage tanks at the ICPP. The tank heels will be flushed and neutralized. Tank internals will be sprayed to remove solid contamination. The remaining heel will be stabilized with grout. The tanks and vaults will be filled with clean grout. The tank voids will be filled with CERCLA soil. Finally, the tank farm will be turned over to CERCLA to monitor."

11.5.6.2 Assumptions. The following assumptions were made for this option. The assumptions have a direct impact on the total estimated cost.

1. All of the field work will be accomplished by Force Account personnel or operations personnel. LMITCO personnel will design, manage, and acquire permits.

2. This estimate is intended to cover project costs from project authorization to turnover. No distinction was made for "color of money."

3. The percentages used for Design, Inspection and, to some extent, Construction Management are slightly lower than those regularly used on an effort of this size. Much of the closure involves repetitive work after filling the first tank with grout.

4. Project Management will maintain a fairly high level of involvement throughout the closure period.

5. The proposed schedule is:

Design -	2000 to 2005
Solidify Heel -	2005 to 2018
Fill Vault and Tank Voids with Clean Grout:	
WM-182 – WM-186 -	2013 to 2014
Remaining Tanks -	2020 to 2021.

6. Temporary construction facilities cover craft change and lunch areas, offices, and warehousing.

7. Permitting assumptions: Others will accomplish the EIS. An EA will not be required in addition to the EIS. Delisting of hazards is by others. Postclosure monitoring is CERCLA's responsibility.

8. All excavated soil can be reused as backfill within the TFF.

9. Excavation incorporates shoring to minimize exposure to contaminated dirt.

10. Much of the productivity was based on actual costs incurred on the Tank Farm Upgrades Project.

11. The 'Tank Farm Heel Removal Project' conceptual draft estimate, dated 12/19/94, was used as a reference.

12. Heel and vault grout costs are based on the "sand" grout used in the WCF Deactivation Project.

13. Grout drop tubes can be decontaminated and reused as needed.

14. Grout placement unit labor hours include time for setup and cleaning of grout equipment after each pour.

15. Heel characterization costs represent three sets of samples for each tank.

16. Heel flushing and riser equipment removal costs were confirmed with Dave Machovec.

17. Mounting/support frames were assumed for each piece of riser equipment to distribute their weight as well as to provide a mounting base.

18. The TFF area enclosure is sized to cover as many as four tanks at once with traffic lanes around the perimeter.

19. Heel transfer lines will require shielding from the tanks to the appropriate valve box tie-in.

20. The grout pump will be staged north of Tanks 185 and 186.

21. Spare equipment was estimated where needed.

12. FUTURE STUDIES AND UNCERTAINTIES

This study identified areas of future study and uncertainties associated with the options developed for TFF Closure. These future studies and uncertainties are identified in this section.

12.1 Future Studies

Uncertainties identified during the course of this study must be addressed before initiating TFF Closure. These uncertainties are due to the preliminary nature of this study, evolving regulatory guidance concerning HLW and incidental waste determinations, and schedule constraints.

12.1.1 Tank Heel Characterization

Heel characterization studies should be conducted as soon as possible. Existing heel characterization information is outdated and was not conducted on each tank. Current (up-to-date) heel characteristic data are required for each tank before design, proof of process, and actual closure activities begin. Heel sampling must be conducted in a way that provides an accurate representation of the physical and chemical characteristics of the heel being sampled.

12.1.1.1 Nonsodium-Bearing Waste Heel Characterization. The nonsodium-bearing waste heel contained in WM-188 may have a concentration of radionuclides that precludes meeting the Class C criteria. The actual concentrations will dictate the degree of decontamination required to meet the incidental waste criteria. A study of up-to-date heel data should be conducted to establish any impacts to the identified closure methods.

12.1.2 Schedule Conflicts

Because of the interdependencies between the TFF Closure Project, Calcine Retrieval and Transportation Project, Bin Set Closure Project, NWCF Closure Project, and Waste Treatment Facility, a more detailed study concentrating on the coordination of schedules between the aforementioned groups should be done.

12.1.3 Thermal Analysis

A formal thermal analysis should be done on each tank to estimate the maximum allowable grout lift for each tank. This analysis could impact the estimated schedules for filling the tank voids with grout (either NRC Class C or clean grout.)

12.1.4 NRC Licensing

Because of the preliminary nature of the NRC and DOE negotiations associated with licensing of near-surface LLW disposal areas, it is not possible to predict the impact these future regulations would have on this project. It is noted that the current DOE and NRC radioactive waste disposal regulations are based on the design and construction of new facilities. The TFF, if used for radioactive waste disposal, would be a "retrofit" of an existing mixed waste storage system. This retrofit would require extensive analysis and potential modifications for this new use – radioactive waste disposal. Numerous issues have been identified with the application of the current NRC and DOE requirements to the TFF. TFF compliance with new facility design requirements for LLW disposal would require additional analysis and it is anticipated that not all of the "new construction" requirements would be met by the TFF retrofit.

Resources would have to be allocated to verify that any deviation or variances from the applicable NRC or DOE requirements are equally health-protective as the original requirement.

12.1.5 Grout Characteristics

Experiments and supporting calculations should be conducted to establish the allowable compressive strength and associated characteristics of the grouts used to solidify heel and void filling. These grout formulations must be designed to support the weight of the material placed above it and meet other criteria, such as leachability.

12.1.6 Closure of the 18,400 to 30,000-Gallon Tanks

These tanks associated with the TFF have not been addressed in this study, and will require closure at a future date (to be determined). A study should be initiated to develop information required for closing these tanks. This study would allow the following to occur:

1. Identification of the information required for conducting the closure
2. Development of the Closure Plans with associated schedules and cost estimates
3. Negotiation with the State of Idaho for a submittal schedule of these Closure Plans.

12.1.7 Incidental Waste Determination

Compliance associated with the incidental waste determination requires additional analysis. This is due to the uncertainties in the interpretation of the incidental waste definition and the evolving regulatory direction being provided by the NRC.

12.2 Uncertainties

During the course of this study, areas of uncertainty were identified that could impact the current identified closure and subsequent use options. These uncertainties are discussed below.

12.2.1 Acceptable Risk and Contaminant Levels

There has been a lack of regulatory direction provided from the State of Idaho HWPB associated with acceptable risk levels (10^{-4} to 10^{-6}). This would impact the degree of decontamination required. This will ultimately affect both the schedule and the cost for closing the TFF. In addition, it is anticipated that the HWPB will require a performance level be identified for any contaminants that may remain. The HWPB has identified that it may not be acceptable to leave a residue in place during "clean closure" that, while meeting a predetermined risk assessment level, is technically defined as a hazardous waste. This performance standard may be an LDR treatment standard, groundwater standard, or similar published standard for acceptable levels of potentially hazardous or toxic constituents.

12.2.2 CERCLA Cumulative Risk Levels

No CERCLA cumulative risk levels for the ICPP have been developed and approved to date. It is unknown at this time know how much of the CERCLA cumulative risk levels will be allotted to the TFF. In addition, the actual degree of decontamination required to meet the CERCLA cumulative risk levels for ICPP could impact the TFF Closure methodologies, costs, and schedules presented in this study.

Development of the risk assessment and identification of cumulative risk levels will require coordination between the RCRA and CERCLA programs to identify potential contaminants of concern, transport mechanisms, and receptors.

12.2.3 NRC Class C Waste

There is significant uncertainty about the success of activities associated with closure of the TFF and void filling with Class C waste. Uncertainties include:

1. The nature and amount of waste residue remaining in the bins after closure decontamination
2. The effectiveness of technologies to retrieve wastes
3. The actual waste codes associated with the stored wastes
4. The ability to decontaminate ancillary equipment and piping; costs and short-term health consequences of retrieving residue
5. The long-term hazards associated with residue remaining
6. The impact due to future regulation and associated requirement changes for the action.

12.2.4 Residue Determination

The guidance associated with the residue waste determination as an HLW or an incidental waste is vague or undefined. This includes the applicability of the Nuclear Waste Policy Act (NWPA) to unrecoverable residue in the bins.

12.2.5 Previous DOE Decisions on Grout Stability

Hanford stakeholders identified issues with the grout stability and, based on this input, DOE modified the strategy for management of Hanford tank waste. Concerns about the grout stability resulted in the decision to vitrify the low activity fraction instead of grouting. Unforeseen issues associated with using grout could impact the identified closure and subsequent use methods.

12.2.6 Defense of CLFS Removal Standards

Demonstrating that key radionuclides have been removed to the maximum extent technically and economically practical could require a more detailed defense. The defense for CLFS is expected to be more difficult than for RBCC.

12.2.7 Class C Limits of Tank Residue

Models and parameters need to be reviewed to determine if the Class C Parameters are achievable. This includes additional analysis on the technical basis associated with radionuclide concentration averaging of the tank heels and implaced grout. See also TRU Waste Limits issue.

12.2.8 TRU Waste Limits

If the sum of TRU radionuclides, set by a site-specific Class C limit, exceed 100 nCi/g, the waste might be classified as TRU waste. This would trigger the onsite application of 40 CFR 191, unless DOE has determined, with the concurrence of EPA, that the wastes do not need the degree of isolation required by 40 CFR 191.

12.2.9 Degree of Waste Removal Required for Closure

Currently no agreement exists between DOE-ID and the State of Idaho as to the degree of waste removal (or acceptable risk) that should be used for the development of waste retrieval systems technology, retrieval systems engineering, and the point where retrieval operations are complete.

12.2.10 Floodplain Study

The INEEL floodplain study has not been finalized and is needed for the site assessment analysis. The current preliminary floodplain map for the INEEL shows the TFF inside of the 100-year floodplain. It is unknown whether the final map will identify the TFF as being in a 100-year floodplain. Placement of LLW into the TFF tank voids would not be allowed if the TFF is identified as being inside the 100-year floodplain. Reference Section 5.1.2.3, Item 2d for requirement.

12.2.11 HLW or Incidental Waste Determination: General Issues

The "Incidental Waste Determination" methodology is evolving in its application to emptied HLW storage tanks. The NRC identified in FR 58 no. 41, page 12342 that for empty but still contaminated waste tanks that DOE might dispose of in-place, a case-by-case determination of the appropriate waste classification might be necessary. However, guidance for this determination was not provided. Therefore, the NRC's acceptance of the rationale used for this project's incidental waste determinations is unknown.

12.2.11.1 HLW or Incidental Waste Determination: Unique Wastes at the INEEL. In the NRC's analysis of the Hanford HLW tank issues, the NRC declined to initiate rulemaking that would establish procedures for determining whether radioactive wastes either are or are not HLW. In declining, the NRC identified that

> "Wastes generated at the Idaho Chemical Processing Plant are markedly different from those at Hanford and Savannah. Therefore, if questions about classification of the Idaho wastes should arise, precedents established at Savannah River and Hanford might be difficult to apply." (FR Vol. 58, No. 41, p 12342).

12.2.11.2 NRC Responsibilities Regarding Incidental Waste Determination. In the NRC's analysis of the Hanford tanks (FR Vol. 58, No. 41, p 12342), the issue as to whether the NRC was adequately informed was addressed. The NRC identified responsibility to "determine whether the activities being undertaken by the Department of Energy fall within the NRC's statutory jurisdiction." Further, the NRC established "As in the case of other persons whose activities may fall within our regulatory sphere, the Commission may from time to time demand information so as to be able to determine whether or not to initiate an enforcement action." Because of the unique aspects of the INEEL waste, it is important to communicate incidental waste determinations and rationale to the NRC. The numerous issues associated with incidental waste determinations will require the development of a comprehensive analysis for each incidental waste determination associated with the closure activity. This analysis would then be available for potential review by the NRC.

***12.2.11.3* Waste Residue Meeting the Incidental Waste Criteria.** The tank closures are contingent upon the residue meeting the incidental waste criteria. This would require a demonstration that the residue is an incidental waste and not HLW based on guidance provided by NRC's Incidental Waste Criteria. Regulatory guidance for demonstrating removal of the "key radionuclides to the maximum extent that is technically and economically practical," in situ has not been established. The methodology and documentation required for demonstrating the achievement of this performance standard must still be developed.

12.2.12 Exemption from NWPA.

A repository for HLW that is used only for atomic energy defense activity is exempt from the requirements of the NWPA [NWPA Section 8(b)]. This exemption should be further researched to identify possible alternative paths for the management of HLW in tanks.

12.2.13 Clean Closure Performance Standards

The Idaho Hazardous Waste Permitting Bureau (HWPB) has verbally identified a potential issue concerning performance standards for residue remaining in a system even though "clean closure" performance standards are achieved. However, the HWPB has not provided guidance concerning acceptable performance standards for this residue. Possible performance criteria could include:

1. The residue would be below the maximum concentration of contaminants for the toxicity characteristic (Table 1, 40 CFR 261.24) for contaminants of concern

2. The residue would meet the universal treatment standards (40 CFR 268.48) for contaminants of concern.

3. No additional decontamination being necessary if all residues and waste have been identified as being removed and only limited system contaminants remain following aggressive decontamination efforts.

It is unknown what organization will be performing the landlord function for any required long-term monitoring and maintenance activities that would be required by closure to landfill standards.

12.2.14 Separate CERCLA RI/FS

A separate RI/FS will be performed for the TFF. The outcome of this study is unknown at this time. The current schedule for the TFF RI/FS indicates a draft ROD will be issued by December 2003. This ROD could affect the proposed closure methods, costs, schedule, and assumptions associated with the identified hand-off to the CERCLA program of the capping, monitoring, and maintenance activities.

12.2.15 Heel Characteristics

Existing heel characterization information is outdated and was not conducted on each tank. The actual heel characteristics could impact the identified closure methods and associated cost and schedule estimates.

12.2.15.1 Nonsodium-Bearing Waste. The nonsodium-bearing waste heel contained in WM-188 may have a concentration of radionuclides that precludes meeting Class C criteria. This could impact the identified closure methods and associated cost and schedule estimates.

12.2.16 Schedule for Closure of the 18,400 and 30,000-Gallon Tanks

The date for submittal of a Closure Plan to the State of Idaho and the subsequent closure of the 18,400 and 30,000-gallon tanks has not been identified. While the closure of these tanks is outside the scope of this study, this could impact the TFF cost and schedule if the closure of these tanks would conflict with the TFF Closure schedule (e.g, be scheduled to occur concurrently with the TFF Closure).

Appendix A

Project Data Sheets

CONTENTS

TABLES

A-1. PROJECT DATA SHEETS

Project data sheets have been developed for each option presented in this report.These data sheets provide summary information on the following topics:

1. General Information
2. Construction or D&D Information
3. Operational Information.

Each project data sheet is presented in table form, starting with Table A-1 and ending with Table A-6.The table headings are:

1. **Table A-1.**Project data sheet for Tank Farm Closure – Option 1 (TRCC)
2. **Table A-2.**Project data sheet for Tank Farm Closure – Option 2 (RBCC: LLW Landfill)
3. **Table A-3.**Project data sheet for Tank Farm Closure – Option 3 (RBCC: CERCLA fill)
4. **Table A-4.**Project data sheet for Tank Farm Closure – Option 4 (CLFS: LLW Landfill)
5. **Table A-5.**Project data sheet for Tank Farm Closure – Option 5 (CLFS: CERCLA fill)
6. **Table A-6.**Project data sheet for Tank Farm Closure – Option 6 (CLFS: Clean fill).

NOTE: EDF-TFC-040 provides the basis for each data sheet table.

Section A-2 contains the supporting calculations used to build these tables.

Table A-1. Project Data Sheet for Tank Farm Closure — Option 1 (TRCC).

Generic Information	
Description/Function:	ICPP Tank Farm Closure – Option 1 (Total Removal Clean Closure)
EIS Alternative:	Facility Disposition
Project Type: Waste Stream:	Waste Management Program – Tank Farm Facility Closure Mixed Low-Level Waste, LLW, CERCLA Wastes
Action Type:	D&D on an existing facility
Structure Type:	Eleven 300,000 gallon underground stainless steel storage tanks and associated concrete vaults.The tanks are 50 feet in diameter with an overall height of approximately 30 feet.The tanks are enclosed in the concrete vaults. Temporary weather enclosures will cover portions of the Tank Farm Facility (TFF) during the clean closure activities.
Size (m^2):	11,460 (Fig. 7-1, "ICPP Tank Farm Closure Study")

Table A-1.(continued).

Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, structures, and process equipment used in the closure activities. An LLW Disposal Site occupying approximately 10 acres is proposed for this option.The location of the LLW Disposal Site has not been determined.
Location:	Total Removal Clean Closure will take place inside the Idaho Chemical Processing Plant (ICPP) fenced boundary. The location of the LLW Disposal Site has not been determined but is assumed that the site will be located at the INEEL.
Candidate for Privatization?:	No
Construction Information	
Cost ($):Preconstruction	$ 87,799,000
Cost ($):Construction/D&D	$ 5,243,657,000
Schedule Start/End:Preconstruction	
Permitting and Oversight:	2008 – 2035
Process Development:	2003 – 2007
Institutional Controls:	2003 – 2035
Treatability Studies:	2007 – 2009
Schedule Start/End:Construction	
Site Prep – Subcontract:	2009 – 2012
Heel Removal:	2010 – 2024
Site Prep – LMITCO:	2024 – 2025
Soil Stabilization:	2024 – 2028
Soil Removal, D&D Activities:	2027 – 2034
Waste Disposal:	2027 – 2034
Post-excavation Activities:	2034 – 2036
Debris Cleaning Facility:	2023 – 2029
LLW Disposal Site:	2023 – 2029
No. of workers each year of construction or D&D: (new/existing/radiation) New: Existing: Radiation:	Average # of workers/year = 326 33 293 326 (includes all employees)
Average annual worker radiation dose (rem/yr):	1.07 Rem/yr
Heavy Equipment	

Table A-1.(continued).

Equipment used:	Gantry Cranes, Boom Crane, Excavators/Backhoes, Front-End Loaders, Concrete Pulverizer, Plate Shear, Vibratory Pile Extractor, Low-Boy Truck & Trailer
Trips:	8,761 round trips between the TFF, Waste Experimental Reduction Facility (WERF), Debris Treatment Facility, LLW Disposal Site, and the Industrial Landfill. An average distance of 10 miles/round trip is assumed.
Hours of Operation:	3,016,182
Acres Disturbed	
New:	None
Previous:	2.83 acres in the TFF 10 acres for a LLW Disposal Site
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides, americium through zirconium were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions comprised mainly of the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates, and unburned hydrocarbons
Quantity (tons/year):	54,450
Effluents	
Type: Quantity (liters):	Hazardous (Chemical) 38,000
Type: Quantity (liters):	Mixed Waste 4,384,000
Solid Wastes	
Type: Quantity (m^3):	Industrial Landfill Material (demolished buildings, structural steel, concrete, wood, etc.) 117,000
Radioactive Waste	
Type: Quantity (m^3):	Low-Level Waste (Incinerable Waste) 20
Type: Quantity (m^3):	Low-Level Waste (Disposed directly in LLW Disposal Site) 1,100
Type: Quantity (m^3):	Mixed Waste (Requires further treatment) 7,100
Total Curies:	22,750 (total for the above wastes)

Table A-1.(continued).

CERCLA Waste	
Type:	Soils removed from the TFF
Quantity (m^3):	133,800
Total Curies:	46,200
Hazardous/Toxic Chemicals	
Type: Storage/Inventory (liters):	Aluminum Nitrate 19,000
Type: Storage/Inventory (liters):	Nitric Acid 19,000
Hazardous Waste Generated (kg):	120
Pits/Ponds Created (m^2):	40,500 (LLW Disposal Site)
Water Usage (liters):	3,900,000
Source:	Deep wells at ICPP, water is pumped from the Snake River Aquifer
Energy Requirements	
Electrical (MWh/yr):	5,100 MW-hr/yr during the 27-year D&D period
Fossil Fuel (liters):	57,100,000
Permits Needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP)
Remaining Radioactive Material:	Negligible
Remaining Hazardous Material:	Negligible

Table A-2. Project Data Sheet for Tank Farm Closure – Option 2 (RBCC, LLW Fill).

Generic Information	
Description/Function:	Tank Farm Closure – Option 2 (Risk-Based Clean Closure, LLW Fill)
EIS Alternative:	Facility Disposition
Project Type:	Waste Management Program – Tank Farm Facility Closure
Waste Stream:	LLW, Mixed Low-Level Waste (MLLW)
Action Type:	D&D on existing facility
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the TTF will be erected .
Size (m^2):	10,400
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
Candidate for Privatization?:	No
Construction Information	The costs shown below are escalated – see Section 11 of the report for additional detail
Cost ($):Preconstruction	$ 43,800,000
Cost ($):Construction/D&D	$ 140,100,000
Schedule Start/End:Preconstruction	
Regulatory Compliance:	2000 – 2024
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Schedule Start/End:Construction	
Site Preparation:	2006 – 2007
Characterize Heel:	2007– 2016
Tank Isolation:	2007 – 2017
Wash Interior Tank Walls:	2007 – 2017
Solidify Remaining Heel:	2008 – 2019
Clean Vaults:	2010 – 2020
Fill Vault Voids with Clean Grout:	2010 – 2020
Fill Tank Voids with Class C Grout:	2011 – 2024

Table A-2.(continued).

No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 14.8
New:	1.5
Existing:	13.3
Radiation:	14.8 (includes all employees)
Average annual worker radiation dose (rem/yr)	1.15 Rem/yr
Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
Trips:	2,192 round trips (10 miles/round trip between CFA and ICPP)
Hours of Operation:	26,700
Acres Disturbed	
New:	None
Previous:	2.6 acres in the Tank Farm Facility
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates, and unburned hydrocarbons
Quantity (tons/year):	900
Effluents	
Type:	Mixed Waste
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500
Solid Wastes	
Type:	Industrial
Quantity (m^3):	115
Radioactive Wastes	
Type:	Mixed
Quantity (m^3):	2,060
Activity (Ci):	570
Hazardous/Toxic Chemicals	

Table A-2.(continued).

Type:	Nitric Acid
Storage/Inventory:	18,900
Type:	Aluminum Nitrate
Storage/Inventory:	18,900
Pits/Ponds Created (m^2):	37
Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)
Energy Requirements	
Electrical (MWh/yr):	1,150
Fossil fuel (liters):	665,000
Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP)
Remaining Radioactive Material	
Quantity (m^3):	15,600 (LLW grout deposited in tank voids)
Curies:	14,400,000
Remaining Hazardous Material:	Negligible

Table A-3. Project Data Sheet for Tank Farm Closure – Option 3 (RBCC, CERCLA Fill).

Generic Information	
Description/Function	Tank Farm Closure – Option 3 (Risk-Based Clean Closure, CERCLA Fill)
EIS Alternative	Facility Disposition
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW), CERCLA Waste
Action Type	D&D on existing facility
Structure Type	Eleven underground storage tanks (300,000-gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the TTF will be erected .
Size (m^2)	10,400
Other Features (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Location	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
Candidate for Privatization?	No
Construction Information	
Cost ($):Preconstruction	$46,900,000
Cost ($):Construction/D&D	$163,900,000
Schedule Start/End:Preconstruction	
Regulatory Compliance	2000 – 2029
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Site Preparation	2004 – 2013
Characterize Heel	2001– 2017
Tank Isolation	2006 – 2013
Wash Interior Tank Walls	2006 – 2016
Solidify Remaining Heel	2008 – 2018
Clean Vaults	2011 – 2020
Fill Vault Voids with Clean Grout	2013 – 2021
Fill Tank Voids with CERCLA Soil	2022 – 2030

Table A-3.(continued).

No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 11.4
New:	1.1
Existing:	10.3
Radiation:	11.4 (includes all employees)
Average annual worker radiation dose (Rem/yr)	0.95 Rem/yr
Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
Trips:	2,192
Hours of Operation:	32,800
Acres Disturbed	
New:	None
Previous:	2.6 acres in the Tank Farm Facility
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year)	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates, and unburned hydrocarbons
Quantity (tons/year):	750
Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500
Solid Wastes	
Type:	Industrial
Quantity (m^3):	115
Radioactive Wastes	
Type:	Mixed
Quantity (m^3 and Ci):	2,060
Activity (Ci):	570

Table A-3.(continued).

Hazardous/Toxic Chemicals	
Type:	Nitric Acid
Storage/Inventory (liters):	18,900
Type:	Aluminum Nitrate
Storage/Inventory (liters):	18,900
Pits/Ponds Created (m^2):	37
Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)
Energy Requirements	
Electrical (MWh/yr):	1,150
Fossil fuel (liters):	759,000
Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP) The CERCLA Program will meet "applicable or relevant and appropriate requirements" (ARARs)
Remaining Radioactive Material	
Quantity (m^3):	15,600 (CERCLA Waste deposited in tank voids)
Curies:	46,200
Remaining Hazardous Material:	Negligible

Table A-4. Project Data Sheet for ICPP Tank Farm Closure – Option 4 (CLFS, LLW Fill).

Generic Information	
Description/Function:	Tank Farm Closure – Option 4 (Close to RCRA Landfill Standards, LLW Fill)
EIS Alternative:	Facility Disposition
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure LLW, Mixed Low-Level Waste (MLLW)
Action Type:	D&D on existing facility
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the TFF will be erected .
Size (m^2):	10,400
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
Candidate for Privatization?:	No
Construction Information	
Cost ($):Preconstruction	$ 41,800,000
Cost ($):Construction/D&D	$ 123,600,000
Schedule Start/End:Preconstruction	
Regulatory Compliance:	2000 – 2024
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Schedule Start/End:Construction	
Site Preparation:	2005 – 2006
Characterize Heel:	2007 – 2016
Tank Isolation:	2007 – 2017
Wash Interior Tank Walls:	2007 – 2017
Solidify Remaining Heel:	2008 – 2020
Fill Vault Voids with Clean Grout:	2010 – 2021
Fill Tank Voids with Class C Grout:	2011 – 2024

Table A-4.(continued).

No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 11.6
New:	1.2
Existing:	10.4
Radiation:	11.6 (includes all employees)
Average annual worker radiation dose: (rem/yr)	1.38 Rem/yr
Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
Trips:	2,192
Hours of Operation:	22,300
Acres Disturbed	
New:	None
Previous:	2.6 acres in the Tank Farm Facility
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates, and unburned hydrocarbons
Quantity (tons/year):	850
Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500
Solid Wastes	
Type:	Industrial
Quantity (m^3):	115
Radioactive Wastes	
Type:	Mixed
Quantity (m^3):	2,060
Activity (Ci):	570
Hazardous/Toxic Chemicals	

Table A-4.(continued).

Type:	Nitric Acid
Storage/Inventory:	18,900
Type:	Aluminum Nitrate
Storage/Inventory:	18,900
Pits/Ponds Created (m^2):	37
Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)
Energy Requirements	
Electrical (MWh/yr):	1,150
Fossil fuel (liters):	578,000
Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP)
Remaining Radioactive Material	
Quantity (m^3):	15,600 (LLW grout deposited in tank voids)
Curies:	14,500,000
Remaining Hazardous Material (kg):	600

Table A-5. Project Data Sheet for ICPP Tank Farm Closure – Option 5 (CLFS, CERCLA Fill).

Generic Information	
Description/Function:	Tank Farm Closure – Option 5 (Close to RCRA Landfill Standards, CERCLA Fill)
EIS Alternative:	Facility Disposition
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW), CERCLA Waste
Action Type:	D&D on existing facility
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the tank farm will be erected .
Size (m^2):	10,400
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
Candidate for Privatization?:	No
Construction Information	
Cost ($):Preconstruction	$ 46,300,000
Cost ($):Construction/D&D	$ 148,600,000
Schedule Start/End:Preconstruction	
Regulatory Compliance:	2000 – 2030
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Schedule Start/End:Construction	
Site Preparation:	2004 – 2013
Characterize Heel:	2001 – 2017
Tank Isolation:	2006 – 2013
Wash Interior Tank Walls:	2006 – 2016
Stabilize Remaining Heel:	2008 – 2018
Fill Vault Voids with Clean Grout:	2022 – 2030
Fill Tank Voids with CERCLA Soil:	2013 – 2021

Table A-5.(continued).

No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 8.8
New:	0.9
Existing:	7.9
Radiation:	8.8 (includes all employees)
Average annual worker radiation dose: (rem/yr)	1.14 Rem/yr
Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
Trips:	2,192
Hours of Operation:	31,382
Acres Disturbed	
New:	None
Previous:	2.6 acres in the Tank Farm Facility
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Ci/yr) :	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year) :	720
Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500
Solid Wastes	
Type:	Industrial
Quantity (m^3) :	115
Radioactive Waste	
Type:	Mixed
Quantity (m^3):	2,060
Activity (Ci):	570

Table A-5.(continued).

Hazardous/Toxic Chemicals	
Item:	Nitric Acid
Inventory/ Storage (liters):	18,900
Item:	Aluminum Nitrate
Inventory/ Storage (liters):	18,900
Pits/Ponds Created (m^2):	37
Water Usage(liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)
Energy Requirements	
Electrical (MWh/yr)	1,150
Fossil fuel (liters)	724,000
Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm water Pollution Prevention Plan (SWPPP) The CERCLA Program will meet "applicable or relevant and appropriate requirements" (ARARs)
Remaining Radioactive Material	
Quantity (m^3):	15,600 (CERCLA Waste deposited in tank voids)
Curies:	160,000
Remaining Hazardous Material (kg):	600

Table A-6. Project Data Sheet for ICPP Tank Farm Closure – Option 6 (CLFS, Clean Fill).

Generic Information	
Description/Function:	Tank Farm Closure – Option 6 (Close to RCRA Landfill Standards, Clean Fill)
EIS Alternative:	Facility Disposition
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW)
Action Type:	D&D on existing facility
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure will be erected
Size (m^2):	10,400
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities
Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
Candidate for Privatization?:	No
Construction Information	
Cost ($):Preconstruction	$ 25,400,000
Cost ($):Construction/D&D	$ 96,300,000
Schedule Start/End:Preconstruction	
Regulatory Compliance:	2002 – 2021
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Schedule Start/End:Construction	
Site Preparation:	2004 – 2013
Characterize Heel:	2001 – 2017
Tank Isolation:	2006 – 2013
Wash Interior Tank Walls:	2006 – 2016
Solidify Remaining Heel:	2008 – 2018
Fill Vault and Tank with Clean Grout:	2013 – 2021
No. of workers each year of construction or D&D: (new/existing/radiation) New: Existing: Radiation:	Average # of workers/year = 10.6 1.1 9.5 10.6 (includes all employees)

Table A-6.(continued).

Average annual worker radiation dose (Rem/yr):	1.33 Rem/yr
Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
Trips:	3,993 round trips (100 miles per round trip)
Hours of Operation:	24,300
Acres Disturbed	
New:	None
Previous:	2.6 acres in the Tank Farm Facility
Revegetated:	None
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates,, and unburned hydrocarbons
Quantity (tons/year):	1,050
Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	80,000
Solid Wastes	
Type:	Industrial
Quantity (m^3):	115
Radioactive Wastes	
Type:	Mixed
Quantity (m^3):	2,040
Activity (Ci):	30
Hazardous/Toxic Chemicals	
Item:	Nitric Acid
Inventory/ Storage (liters):	18,900
Item:	Aluminum Nitrate
Inventory/ Storage (liters):	18,900

Table A-6.(continued).

Pits/Ponds Created (m^2):	37
Water Usage (liters):	1,760,000
Source:	ICPP Deep Wells (Snake River Aquifer)
Energy Requirements	
Electrical (MW-hr/yr):	1,150
Fossil fuel (liters):	656,000
Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm water Pollution Prevention Plan (SWPPP)
Remaining Radioactive Material	
Quantity (m^3):	600
Curies:	114,000
Remaining Hazardous Material (kg):	600

A-2. SUPPORTING DATA AND CALCULATIONS

Table 1. Project data sheet for Tank Farm Closure – Option 1 (Total Removal Clean Closure)

NOTE: All information in this table is from the "ICPP Tank Farm Closure Study 90% Draft" and the cost estimates (Volume III) associated with the 90% Draft.

Generic Information	
Description/Function:	ICPP Tank Farm Closure – Option 1 (Total Removal Clean Closure)
This is the title of the project data sheet	
EIS Alternative:	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program – Tank Farm Facility Closure Mixed Low-Level Waste, LLW, CERCLA Wastes
Per explanation on page C-1 of Halliburton NUS Corp. data requirements and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "environmental restoration". ***Mixed waste, LLW, and CERCLA Waste will be the products coming out of the Tank Farm.***	
Action Type:	D&D on an existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type:	Eleven 300,000 gallon underground stainless steel storage tanks and associated concrete vaults. The tanks are 50 ft. in diameter with an overall height of approximately 30ft. The tanks are enclosed in the concrete vaults. Temporary weather enclosures will cover portions of the Tank Farm during the clean closure activities.
This study concerns total removal of the 11 underground storage tanks and vaults. Weather enclosures will be constructed over portions of the tank farm so that closure activities can take place throughout the year.	
Size (m^2):	11,460 (Fig. 7-1, "ICPP Tank Farm Closure Study")
From Fig. 7-1 of the "ICPP Tank Farm Closure Study", the area where closure activities will take place encompasses an area that is 247' x 557' with the exception of a corner in the southeast area of the tank farm that measures 71' x 200'. The area is calculated below. ***Area = 247' x 557' – (71' x 200') = 123,379 ft² = 11,462 m²***	
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, structures, and process equipment used in the closure activities. A LLW Disposal Site occupying approximately 10 acres is proposed for this option. The location of the LLW Disposal Site has not been determined.

Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup. The disposal site will be used to dispose of LLW removed from the tank farm.

Location:	Total Removal Clean Closure will take place inside the Idaho Chemical Processing Plant (ICPP) fenced boundary. The location of the LLW Disposal Site has not been determined but is assumed that the site will be located at the INEEL.

The Tank Farm Facility is located at ICPP, exact location of the proposed disposal site is to be determined.

Candidate for Privatization?:	No

The work to be performed is D&D in nature and does not involve construction and operation of a facility.

Construction Information	
Cost ($):Preconstruction	$87,799,000

Permitting and Oversight	$10,100,000
Process Development	15,700,000
Institutional Controls	24,366,000
Treatability Studies	37,633,000
Total PreConstruction	**$87,799,000**

Preconstruction costs cited above are from the Option 1 cost estimates.

Cost ($):Construction/D&D	$5,243,657,000

Initial Phased Remedies	$36,495,000
Site Prep - Subcontract	57,000,000
Heel Removal	517,000,000
Site Prep - LMITCO	87,493,000
Soil Stabilization	411,500,000
Soil Removal, D&D Activities	2,998,579,000
Waste Disposal	428,628,000
Post Excavation Activities	431,462,000
Debris Cleaning Facility	224,500,000
LLW Disposal Site	51,000,000
Total Construction/D&D	**$5,243,657,000**

Construction costs cited above are from the Option 1 cost estimates.

Schedule Start/End:Preconstruction	
Permitting and Oversight:	2008 – 2035
Process Development:	2003 – 2007
Institutional Controls:	2003 – 2035
Treatability Studies:	2007 – 2009

Schedule dates are from the Option 1 cost estimates.	
Schedule Start/End:Construction	
Site Prep – Subcontract:	2009 – 2012
Heel Removal:	2010 – 2024
Site Prep – LMITCO:	2024 – 2025
Soil Stabilization:	2024 – 2028
Soil Removal, D&D Activities:	2027 – 2034
Waste Disposal:	2027 – 2034
Post Excavation Activities:	2034 – 2036
Debris Cleaning Facility:	2023 – 2029
LLW Disposal Site:	2023 – 2029
Schedule dates are from the Option 1 cost estimates.	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 326
New:	33
Existing:	293
Radiation:	326 (includes all employees)

Several assumptions were made to arrive at the estimated number of workers required.

The assumptions are:

1. *Estimates are given for the average number of workers per year that will be required to complete TFF closure.*
2. *The average number of worker per year is based on D&D activities that begin with Site Preparation in 2009 and conclude with post excavation activities in 2036 for a total of 27 years.*
3. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97). This ratio assumes a 10% worker turnover rate.*
4. *Subcontract labor hours = (Total Subcontract Cost – G&A,PIF)*0.55/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
5. *Total number of construction labor hours = Total labor hours +Subcontract labor hours*
6. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
7. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	Hours
Site Prep/Subcontract	6,240
Heel Removal	148,873
Site Prep/LMITCO	130
Soil Stabilization	0
D&D Activities	4,740
Waste Disposal	0
Post Excavation Activities	161,769
Debris Cleaning Facility	0
SUBTOTAL HOURS	321,752

SUBCONTRACT HOURS

Activity	Total S/C ($)	G&A,PIF($)	S/C -G&A/PIF ($)	Hours*
Site Prep/Subcontract	25,146,785	1,575,285	23,571,500	392,858
Heel Removal	196,337,532	2,918,848	193,418,684	3,223,645
Site Prep/LMITCO	7,391,464	7,232,984	158,480	2,641
Soil Stabilization	133,535,749	7,379,749	126,156,000	2,102,600
D&D Activities	413,567,364	1,950,691	411,616,673	6,860,278
Waste Disposal	87,268,063	245,988	87,022,075	1,450,368
Post Excavation Activities	24,533,038	990,928	23,542,110	392,369
Debris Cleaning Facility	68,585,462	3,029,062	65,556,400	1,092,607
SUBTOTAL HOURS				15,517,365

**Subcontract labor hours calculated per Assumption #5 formula.*

Total Labor Hours = 321,752 + 15,517,365= 15,839,117 hours

D&D Time Period= 27 years (2009 – 2036)

Average Number of Employees per Year = 15,839,117/27/1800= 326Employees/Year

#of existing workers per year=326x 90% = 293 existing workers/year

#of new workers per year=326x 10%=33 new workers/year

Note: These numbers appear on the high side, assumptions or estimates may need to be revised at a future date if warranted.

Average annual worker radiation dose (rem/yr):	1.07 Rem/yr

EDF-TFC-020 ("Exposure Calculations for Total Removal Clean Closure of the Tank Farm") estimates the cumulative radiation exposure for the "Total Removal Clean Closure" option.According to the EDF, the estimated radiation exposure would be 9,433 Rem.If we assume that the radiation exposure is accumulated over a 27 year D&D period equally among the 326 employees, the yearly employee exposure rate is

9433 Rem/27 years/326 employees = 1.07 Rem/yr/employee

Heavy Equipment	
Equipment used:	Gantry Cranes, Boom Crane, Excavators/Backhoes, Front-End Loaders, Concrete Pulverizer, Plate Shear, Vibratory Pile Extractor, Low-Boy Truck & Trailer

These are the principal pieces of heavy equipment that will be used.

Trips:	8,761 round trips between the TFF, Waste Experimental Reduction Facility (WERF), Debris Treatment Facility, LLW Disposal Site, and the Industrial Landfill. An average distance of 10 miles/round trip is assumed.

The number of trips between the TFF, WERF, LLW Disposal Site, Debris Treatment Facility, and Industrial Landfill is calculated by determining the waste volumes for each category and then approximating the amount of waste that can be removed per truckload.

A average 10-mile round trip is assumed for the 4 destinations.

Destination	*Waste Type*	*Volume (ft^3)*	*Volume (yd^3)*	*Volume(yd^3) per trip*	*# of Trips*
WERF (LLW membrane)	*LLW(incinerable)*	*700*	*26*	*10*	*3*
LLW Disposal Site	*LLW*	*38,929*	*1,442*	*10*	*144*
Debris Treatment Facility	*Mixed*	*252,116*	*9,338*	*10*	*934*
Industrial Landfill	*Industrial*	*4,147,263*	*153,602*	*20*	*7,680*
TOTAL # OF ROUND TRIPS					*8,761*

Hours of Operation:	3,016,182

The number of hours that fossil fuel burning equipment will be used was estimated by multiplying the number of labor hours by 25%, i.e.,

Equipment Usage (hrs) = Activity Labor Hours x 25%

Below are activities, labor hours, and the assumed hours that equipment would be operated.

Activity	*Labor Hours*	*Equipment Hours*
Soil Stabilization	*0*	*0*
D&D Activities	*4,740*	*1,185*
Waste Disposal	*0*	*0*
Post Excavation Activities	*161,769*	*40,442*
Debris Cleaning Facility	*0*	*0*
SUBTOTAL HOURS	*166,509*	*41,627*

Activity	*Total S/C ($)*	*G&A,PIF($)*	*S/C -G&A/PIF ($)*	*Labor Hours**	*Equipment Hours*
Soil Stabilization	*133,535,749*	*7,379,749*	*126,156,000*	*2,102,600*	*525,650*
D&D Activities	*413,567,364*	*1,950,691*	*411,616,673*	*6,860,278*	*1,715,069*
Waste Disposal	*87,268,063*	*245,988*	*87,022,075*	*1,450,368*	*362,592*
Post Excavation Activities	*24,533,038*	*990,928*	*23,542,110*	*392,369*	*98,092*
Debris Cleaning Facility	*68,585,462*	*3,029,062*	*65,556,400*	*1,092,607*	*273,152*
SUBTOTAL HOURS				*11,898,221*	*2,974,555*

Equipment Hours = 41,627 + 2,974,555 = 3,016,182 hours

Acres Disturbed	
New:	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous:	2.83 acres in the Tank Farm Facility 10 acres for a LLW Disposal Site

It is assumed that all of the area included in the Tank Farm Facility will be disturbed during Total Removal Clean Closure.

From Fig. 7-1 of the "ICPP Tank Farm Closure Study", the area where closure activities will take place encompassesan area that is 247' x 557' with the exception of a corner in the southeast area of the tank farm that measures 71' x 200'.The area is calculated below.

Area = 247' x 557' – (71' x 200') = 123,379 ft²

123,379 ft² x 1 acre/43,560 ft² = 2.83 acres

The size and location of the Debris Treatment Facility has not been determined.

It is assumed that the proposed LLW Disposal Site will probably be established in an area that has been previously disturbed and will occupy approximately 10 acres.

Revegetated	None

Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.

Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides, americium thru zirconium were calculated and then added together to obtain a total release rate of 0.031 curies/year)

This information comes from EDF-TFC-043. The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year. Refer to the EDF for the complete listing and associated release rates of the individual radionuclides.

Type:	Chemical – fuel combustion emissions comprised mainly of the following constituents: CO, CO_2, H^2O, N_2, NO, O_2, SO_2, particulates, and unburned hydrocarbons

The main source of emissions will be from heavy equipment fuel combustion.

Quantity (tons/year):	54,450

Estimated fuel usage is 57,100,000 liters over a 27 year period..

Fuel usage/year = 57,100,000 liters/27 years = 2,115,000 liters/year. This information was entered into Rod Kimmitt's spreadsheet to obtain the above numbers.

The spreadsheet with the generated numbers is included as an attachment.

Effluents	
Type: Quantity (liters):	Hazardous (Chemical) 38,000
Type: Quantity (liters):	Radioactive (mixed liquid) 4,384,000

The TRCC cost estimate was reviewed for effluents that will be generated during closure activities. Most of the effluents that require further treatment/processing will be generated during heel removal. The volumes and types of effluents are presented in the table below.

Activity	*Waste Type*	*Volume(gal)*	*Volume(lit)*
Tank Isolation & RCRA Cleanup (1.3.2)			
Disposal of Coolant & Flushing Fluid	*Hazardous*	*10,000*	*37,850*
Treatment of Liquid Waste (1.4.1)			
Treatment of Low-Level Liquid Waste	*Radioactive*	*135,240*	*511,883*
Treatment of High-Level Liquid Waste	*Radioactive*	*1,023,000*	*3,872,055*
SUBTOTAL RADIOACTIVE WASTE		*1,158,240*	*4,383,938*

Solid Wastes	
Type:	Industrial Landfill Material (demolished buildings, structural steel, concrete, wood, etc.)
Quantity (m^3):	117,000

A table in the D&D Activities section estimates waste volumes that would result from Total Removal Clean Closure. The table is located on page E-114 of the cost estimate.

Since this particular question is concerned with nonradioactive, nonhazardous solid wastes, the applicable section of the table has a column heading of "Industrial Landfill". The estimated volume is 4,147,263 ft^3 = 117,438 m^3

Radioactive Waste	
Type:	Low-Level Waste (Incinerable Waste)
Quantity (m^3):	20
Type:	Low-Level Waste (Disposed directly in LLW Disposal Site)
Quantity (m^3):	1,100
Type:	Mixed Waste (Requires further treatment)
Quantity (m^3):	7,100
Total Curies:	22,750 (total for the above wastes)

Radioactive Tank Waste

A table in the D&D Activities section estimates waste volumes that would result from Total Removal Clean Closure.The table is located on page E-114 of the cost estimate.

Since this particular question is concerned with radioactive waste, three classifications in the table that apply are:

LLW WERF, LLW, and MIXED.The waste volumes for each classification are given below.

LLW (WERF):700 ft^3 = 20 m^3

LLW (LLW Deposition):38,929 ft^3 = 1,102 m^3

MIXED:252,116 ft^3 = 7,139 m^3

Radioactive Tank Waste, Total Curies

The curie total is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any radioactive waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Rick Gavalya calculated the curie contribution from the liquid portion of the 12" heel.Table 16 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the curie content of the 12" heel.Table 16 shows the activities in milliCuriesi/liter for the radioactive components of the heel.The total mCi/liter for each tank was added up and is presented in the table below.

Tank #	mCi/liter	Heel Volume (gal)	Heel Volume (liters)	Curies/Tank
WM-180	55.99	14,688	55,594	3,113
WM-181	67.97	14,688	55,594	3,779
WM-182	1,382.44	14,688	55,594	76,855
WM-183	477.54	14,688	55,594	26,548
WM-184	52.67	14,688	55,594	2,928
WM-185	247.02	14,688	55,594	13,733
WM-186	78.56	14,688	55,594	4,367
WM-187	496.07	14,688	55,594	27,579
WM-188	670.02	14,688	55,594	37,249
WM-189	233.82	14,688	55,594	12,999
WM-190	16.54	14,688	55,594	920
TOTAL COMBINED CURIES FOR ALL TANKS =				210,070

Adding the curie contribution for each tank yields a total curie count = 210,070.This is representative of what the curie total would be for the liquid portion of the heels at the beginning of D&D.

Mac McCoy researched the heel solids to estimate the curie content.10 of the 11 tanks have approximately 1" of solids while the remaining tank has about 4" of solids.The total curie amount contributed by the solids was estimated to be 245,000 curies.Refer to the attached writeup for calculations.

Adding the two totals together yields 455,070 curies (210,070 + 245,000).This is the assumed curie total at the beginning of D&D activities.

Initial Total Curies in Tanks at beginning of D&D = 455,070 Ci

If we assume that 95% of the liquid waste and solids is removed from the tank through cleaning efforts (and subsequently processed), 5% of the waste will remain in the tanks that contaminates material removed from the TFF, i.e.,

455,070 Ci x 5% = 22,754 Ci

CERCLA Waste	
Type:	Soils removed from the Tank Farm Facility
Quantity (m^3):	133,800
Total Curies:	46,200

Asked Rene Rodriguez if there was information about the # of curies in the TFF soils.Rene referred me to a document titled "Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL – Part A, RI/BRA Report (Final)", DOE/ID-10534, November 1997.Table 5-42 on page F5-55 and F5-56 summarizes the known releases of radionuclides in the Tank Farm area.The table also shows the curies for each radionuclide.

Adding up the curies for each radionuclide yields a combined total=46,180 Ci

Table 5-42 is included as an attachment.

Hazardous/Toxic Chemicals	
Type:	Aluminum Nitrate
Storage/Inventory (liters):	19,000
Type:	Nitric Acid
Storage/Inventory (liters):	19,000

Talked with Dave Machovec on 1-26-98 to find out how much aluminum nitrate and nitric acid are stored typically.Dave stated that there are two 5,000 gallon tanks designated for the aluminum nitrate and nitric acid.Since TRCC will require a large volume of decon solutions, additional temporary tanks may be installed in the future.For the present though, the storage capacity is assumed to be 5,000 gallons each.

Hazardous Waste Generated (kg):	120

The hazardous waste amount is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any hazardous waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Table 12 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the hazardous waste content of the 12" heel.Table 12 shows the molarity of six RCRA wastes in the 11 tanks.The waste molarities were averaged and then converted to g/liter.The total mass of each RCRA waste was then calculated.The results are presented in the table below.

RCRA Waste	Ave. Molarity (moles/liter)	Mole Wt. (g/mole)	Conc. (g/liter)	Heel Volume 11 tanks (gal)	Heel Vol. (liters)	Total Mass (kg)	5% Mass (kg)
Cadmium	0.0031	112.4	0.3484	161,568	611,535	213	10.7
Chromium	0.0051	52.0	0.2652	161,568	611,535	162	8.1
Fluoride	0.1250	19.0	2.3750	161,568	611,535	1,452	72.6
Lead	0.0010	207.2	0.2072	161,568	611,535	127	6.3
Mercury	0.0029	200.6	0.5817	161,568	611,535	356	17.8
Nickel	0.0022	58.7	0.1291	161,568	611,535	79	3.9
5% OF RCRA WASTE TOTAL MASS =							119.5

If we assume that 95% of the liquid waste is removed from the tank through cleaning efforts (and subsequently processed), 5% of the waste will remain in the tanks that contaminates material removed from the TFF, i.e.,

2,389 kgx 5%= 119.5 kg of RCRA wastes left behind

Pits/Ponds Created (m^2):	40,500 (LLW Disposal Site)

A new LLW Disposal Site is proposed for disposition of LLW resulting from D&D activities. The estimated size of the disposal site is 10 acres (from the cost estimates, "LLW Disposal Site", E-159).

10 acres=435,600 ft^2=40,467 m^2

Water Usage (liters):	3,900,000
Source:	Deep wells at ICPP, water is pumped from the Snake River Aquifer

Water will be used mainly in tank washdown, heel removal and decontamination functions. The water usage will be directly related to the volume of effluents that was determined earlier.

If we assume that 90% of the generated effluents is water, then

1,158,240galx 90%=1,042,416gal= 3,945,544 liters

This would yield an average of roughly 100,000 gallons per tank.

Energy Requirements	
Electrical (MWh/yr):	5,100 MW-hr/yr during the 27 year D&D period

Electrical estimators were asked to estimate the typical building load demand per square foot. A range of 3-6 watts/ft^2 of building space was estimated.

The weather enclosure dimensions stated in Section 7.1.3.1 of the 90% Draft Report are 260' x 360' with an extension of 180' x 200'. This yields a square footage = 260' x 360' + 180' x 200'=129,600 ft^2

Assuming a midrange of 4.5 watts/ft^2 for the load,

Electrical Demand = 129,600 ft^2x4.5 watts/ft^2x 24 hrs/dayx 365 days/yr = 5,108 MW-hrs/yr

Fossil Fuel (liters):	57,100,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, cranes, cement trucks, flat-beds, etc.). Below are assumptions upon which fuel consumption is based.

1. *The number of hours that fossil fuel burning equipment will be used for activities such as Soil Stabilization was estimated by multiplying the number of labor hours by 25%, i.e.,*

   Equipment Usage (hrs) = Activity Labor Hours x 25%

2. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment". Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates. Average fuel consumption rates are shown below. Photocopies of applicable pages from the reference guide are included as an attachment.*

   Crane Usage = 4.65 gal/hr

   Backhoe = 2.45 gal/hr

   Front-end loader = 4.03 gal/hr

   Grader = 4.31 gal/hr

   Cement Truck = 9.80 gal/hr

   Average fuel consumption = (4.65 + 2.45 + 4.03 + 4.31 + 9.80)/5= 5.0 gal/hr

   [Since fuel consumption rates are not available for the other heavy equipment listed previously (pulverizers, shears, extractors, etc.,), the average consumption rate of 5.0 gallons/hr will be assumed.]

3. *Construction/D&D activities begin with Site Preparation in 2009 and conclude with Post Excavation Activities in 2036 for a total of 27 years.*
4. *Most of the fuel usage will occur in the years 2022 – 2036. Activities scheduled to take place during this time period include: Soil Stabilization, D&D Activities, Waste Disposal, Post Excavation Activities, Debris Cleaning Facility, LLW Disposal Site. Fuel usage will be based on the hours worked to accomplish these tasks.*
5. *Tables are shown below with the estimated labor hours for normal and subcontract.*

Activity	*Labor Hours*	*Equipment Hours*
Soil Stabilization	*0*	*0*
D&D Activities	*4,740*	*1,185*
Waste Disposal	*0*	*0*
Post Excavation Activities	*161,769*	*40,442*
Debris Cleaning Facility	*0*	*0*
SUBTOTAL HOURS	*166,509*	*41,627*

Activity	*Total S/C ($)*	*G&A,PIF($)*	*S/C -G&A/PIF ($)*	*Labor Hours**	*Equipment Hours*
Soil Stabilization	*133,535,749*	*7,379,749*	*126,156,000*	*2,102,600*	*525,650*
D&D Activities	*413,567,364*	*1,950,691*	*411,616,673*	*6,860,278*	*1,715,069*
Waste Disposal	*87,268,063*	*245,988*	*87,022,075*	*1,450,368*	*362,592*
Post Excavation Activities	*24,533,038*	*990,928*	*23,542,110*	*392,369*	*98,092*
Debris Cleaning Facility	*68,585,462*	*3,029,062*	*65,556,400*	*1,092,607*	*273,152*
SUBTOTAL HOURS				*11,898,221*	*2,974,555*

** Subcontract labor hours = (Total Subcontract Cost – G&A,PIF)*0.55/($33/hr)*

Total Equipment Hrs = 41,627 + 2,974,555 = 3,016,182 hrs

Fuel Usage = 3,016,182 hrs x 5.0 gal/hr = 15,080,910 gallons = 57,081,244 liters

Comment – This fuel usage appears to be very high but is the best that can be calculated given the time constraints and the limited amount of information available.

Permits Needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP)

The information for the permits necessary for TRCC was taken from Section 4, Table 4.1 of the 90% Draft Report.Although the table was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill, the same permits would apply in TRCC since a LLW Landfill would be created to dispose of the LLW removed from the TFF.

Remaining Radioactive Material:	Negligible
Remaining Hazardous Material:	Negligible

The amount of radioactive and hazardous material remaining in the Tank Farm Facility should be negligible after TRCC is complete.Theoretically, only background levels of radioactive and hazardous materials should be detected.

Estimate of Diesel Engine Emissions					
Tank Farm Closure					
- Option 1 -					
Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O2, 79% N2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: C9H18 + 13.5O2 ---->9CO2 + 9H2O					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NOx = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				2,115,000	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				4,187,700	
Total Lbs. of Fuel Used				**4,187,700**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				33,236	
Total Lb-Moles of Fuel (as C9H18)				**33,236**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				104,692,500	
Total Lbs. of Air Added				**104,692,500**	
Lb-Moles of Air for Combustion Fuel				-	
Lb-Moles of Air for Operations Fuel				-	
Lb-Moles of Air for D&D Fuel				**3,610,086**	
Total Lb- Moles of Air				**3,610,086**	
Grand Total of Materials Fed, Lbs.				***108,880,200***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		

NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		13,029,729	6,515	296,130	106,310,747
H2O		5,330,344	2,665	296,130	106,310,747
O2		10,045,529	5,023	313,923	112,698,279
N2		79,855,106.90	39,928	2,851,968	1,023,856,549
Subtotal of Major Gases		**108,260,709**	**54,130**	**3,758,151**	**1,349,176,322**
SO2		81,137	40.6		
Particulates		14,859	7.4		
CO		263,071	131.5		
NOx (assumed NO)		225,489	112.7		
Unburned Hydrocarbons		47,353	23.7		
Subtotal of Contaminants		**631,908**	**316**		
Major Gases and Contaminants - Total			**54,446**	**Tons**	

Table 2. Project data sheet for Tank Farm Closure – Option 2 (RBCC, LLW Fill)

Generic Information

Description/Function:	Tank Farm Closure – Option 2 (Risk-Based Clean Closure, LLW Fill)
This is the title of the project data sheet	
EIS Alternative:	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program – Tank Farm Facility Closure LLW, Mixed Low-Level Waste (MLLW)
Per explanation on page C-1 ("Technical Data Requirements for the INEEL High-Level Waste and Facilities Disposition EIS", Halliburton NUS Corp., Nov. 14, 1997) and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "Environmental Restoration". ***The waste stream should be mixed low-level waste after the heel has been diluted with water during pH adjustment and tank washdown. The tank voids will then be subsequently filled with LLW.***	
Action Type:	D&D on existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the tank farm will be erected .
Relevant structures are the 11 underground storage tanks and vaults. A temporary weather enclosure such as a Sprung Structure will be installed to allow year-round closure work in the tank farm.	
Size (m^2):	10,400
Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'. Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'. ***Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2 = 10,373 m^2***	
Other Features: (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup.	
Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL

The Tank Farm Facility is located at ICPP	
Candidate for Privatization?:	No
The work to be performed is D&D in nature and does not involve construction and operation of a facility.It is assumed that the facility to process CERCLA Waste will be built and operated by the CERCLA Waste Program.	
Construction Information	The costs shown below are escalated – see Section 11 of the report for additional detail
Cost ($):Preconstruction	$ 43,800,000

Regulatory Compliance	$16,100,000
Design	20,900,000
Proof of Process/ORR	6,800,000
Total PreConstruction	**$43,800,000**

Preconstruction costs cited above are from the Option 2 cost estimates (Jan. 21, 1998).

Regulatory Compliance costs include: Air Permitting, Air Monitors, RCRA Closure Plan, Project Management, G&A Adders, etc.,

Also included in Regulatory Compliance costs are activities for Regulatory Affairs Oversite.Although these activities will be ongoing throughout the D&D process and perhaps should be placed with the D&D costs, it would be confusing to extract these costs from this section and place them on the construction side of the cost equation.The oversite costs (without adders and contingency) are about $213,000 and represent a small portion of the overall costs.

Process Development costs include: Conceptual Design, Title Design, Project Management, and Contingency costs.

Cost ($):Construction/D&D	$ 140,100,000

Site Preparation	$11,400,000
Characterize Heel	5,000,000
Tank Isolation	11,000,000
Wash Interior Tank Walls	32,500,000
Solidify Remaining Heel	12,000,000
Clean Vaults	21,400,000
Fill Vault Voids with Clean Grout	13,200,000
Fill Tank Voids with Class-C Grout	33,600,000
Total Construction/D&D	**$140,100,000**

Construction costs cited above are from the Option 2 cost estimates (Jan. 21, 1998).

Schedule Start/End:Preconstruction	
Regulatory Compliance:	2000 – 2024
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006

Schedule dates are from the Option 2 cost estimates (Jan. 21, 1998).

Schedule Start/End:Construction	
Site Preparation:	2006 – 2007

Characterize Heel:	2007– 2016
Tank Isolation:	2007 – 2017
Wash Interior Tank Walls:	2007 – 2017
Solidify Remaining Heel:	2008 – 2019
Clean Vaults:	2010 – 2020
Fill Vault Voids with Clean Grout:	2010 – 2020
Fill Tank Voids with Class C Grout:	2011 – 2024
Schedule dates are from the Option 2 cost estimate (Jan. 21, 1998). ***NOTE: From this point, the following data is based on the 90% Review cost estimates (where applicable).***	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 14.8
New:	1.5
Existing:	13.3
Radiation:	14.8 (includes all employees)

Several assumptions were made to arrive at the estimated number of workers required.

The assumptions are:

8. *Estimates are given for the average number of workers per year that will be required to complete TFF closure.*
9. *The average number of worker per year is based on D&D activities that begin with Site Preparation in 2005 and conclude with filling the tank voids with Class C Grout in 2024 for a total of 19 years.*
10. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97).This ratio assumes a 10% worker turnover rate.*
11. *Subcontract labor hours = (Total Subcontract Cost – G&A,PIF)*0.55/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
12. *Total number of construction labor hours = Total labor hours + ((Total Subcontract Cost – G&A,PIF) *0.55)/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
13. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
14. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	*Hours*
Site Preparation	*22,191*
Tank Isolation	*69,871*
Wash Interior Tank Walls	*112,689*
Stabilize Remaining Heel	*12,252*
Clean Vaults	*109,986*
Fill Vault Voids	*38,182*
Class C Grout in Tank Voids	*89,068*
SUBTOTAL HOURS	*454,239*

SUBCONTRACT HOURS

Activity	*Total S/C ($)*	*G&A,PIF($)*	*S/C -G&A/PIF ($)*	*Hours**
Site Preparation	*1,232,273*	*581,773*	*650,500*	*10,842*
Characterization	*2,587,027*	*607,027*	*1,980,000*	*33,000*
Tank Isolation	*188,922*	*173,922*	*15,000*	*250*
Wash Interior Tank Walls	*1,739,361*	*1,519,361*	*220,000*	*3,667*
Stabilize Remaining Heel	*467,680*	*467,680*	*0*	*0*
Clean Vaults	*624,249*	*624,249*	*0*	*0*
Fill Vault Voids	*1,237,213*	*1,237,213*	*0*	*0*
Class C Grout in Tank Voids	*1,939,587*	*1,674,487*	*265,100*	*4,418*
SUBTOTAL HOURS				*52,177*

**Subcontract labor hours calculated per Assumption #5 formula.*

Total Labor Hours = 454,239 + 52,177= 506,416 hours

D&D Time Period= 19 years (2005 – 2024)

Average Number of Employees per Year = 506,416/19/1800

= 14.8Employees/Year

#of existing workers per year=14.8 x 90% =13.3 existing workers per year

#of new workers per year=14.8 x 10%=1.5 new workers per year

SUPPORTING DATA & CALCULATIONS – OPTION 2

Average annual worker radiation dose (rem/yr)	1.15 Rem/yr

The following assumptions were made when calculating the average worker radiation dose per year.

1. ***For activities where radiation exposure is expected, the estimated #of hours worked in radiation fields will be 30%of the total time estimated for those activities (per conversation with Mac McCoy on 12-17-97).***
2. ***Average radiation dose rates for TFF Closure are given in EDF-TFC-041.***
3. ***The average yearly worker radiation dose is based on a 19-year time frame that begins with Site Preparation in 2005 and concludes with filling the tank voids with Class C grout in 2024 for a total of 19 years.***

Calculations for dosage rates are presented below.The numbers in parentheses are code designators from the Tank Farm Closure Study cost estimates.

SITE PREPARATION

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*5,605*	*1,682*	*1*	*1,682*
Utility Earthwork (1.3.2.1)	*1,850*	*555*	*1*	*555*
Special Construction(1.3.13)	*1,200*	*360*	*1*	*360*
Utilities (1.3.15.1)	*950*	*285*	*1*	*285*
VOG Installation/Removal(1.3.15.2)	*5,129*	*1,539*	*1*	*1,539*
Temporary Power Hookup(1.3.16.2)	*5,108*	*1,532*	*1*	*1,532*
DOSAGE SUBTOTAL				*5,953*

**Rad Exposure = Labor x 30%*

CHARACTERIZATION

ActivityDose Rate(mR/hr)Exposure Time(man-hrs)Dosage(mR)

Characterize Heel(1.3.1)10 3 rad workers x 1 hour/sample1980

x 66 samples = 198 man-hrs _____

DOSAGE SUBTOTAL1980

TANK ISOLATION

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*16,294*	*4,888*	*1*	*4,888*
Isolate Tank Lines(1.3.2.3)	*2,960*	*888*	*1*	*888*
Tank Line Isolation(1.3.15.2)	*18,972*	*5,692*	*1*	*5,692*
Tank Line Isolation(1.3.15.2)	*10,725*	*3,218*	*30*	*96,525*
VOG System(1.3.15.3)	*4,840*	*1,452*	*5*	*7,260*
Tank Elec./Inst. Isolation(1.3.16.1)	*264*	*79*	*1*	*79*
DOSAGE SUBTOTAL				*115,332*

**Rad Exposure = Labor x 30%*

WASH INTERIOR TANK WALLS

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	26,496	7,949	1	7,949
Access Tank Risers(1.3.2.1)	1,760	528	5	2,640
Heel Mixing & Removal(1.3.4.2)	1,760	528	1	528
Heel Mixing & Removal(1.3.4.2)	5,280	1,584	5	7,920
Shielding(1.3.6)	1,760	528	5	2,640
Tank Internal Washdown(1.3.7)	5,280	1,584	1	1,584
Tank Internal Washdown(1.3.7)	16,500	4,950	5	24,750
Equipment Removal(1.3.11.1)				
Remove Jets, Corrosion Coupons	7,040	2,112	5	10,560
Set Up/Remove Rad Tent	7,040	2,112	1	2,112
Cut & Box Removed Equipment	3,520	1,056	5	5,280
Heel Transfer Lines(1.3.15.1)				
Valve Box Tie-In	880	264	30	7,920
Rad Tent, Transfer Line	5,885	1,766	1	1,766
Temporary Power(1.3.16.1)	7,920	2,376	1	2,376
Camera & Lighting(1.3.16.2)	1,760	528	5	2,640
Rad Monitoring System(1.3.16.3)	2,200	660	1	660
DOSAGE SUBTOTAL				81,324

*Rad Exposure = Labor x 30%

STABILIZE REMAINING HEEL

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	2,874	862	1	862
Heel Solidification(1.3.3.3)				
Install/Remove Mounting Frames	2,640	792	1	792
Install/Remove Temp. Shielding	1,760	528	5	2,640
Place Wet/Dry Grout	510	153	1	153
Grout Delivery Piping(1.3.15.5)	1,128	338	1	338
Temporary Power(1.3.16.1)	2,200	660	1	660
DOSAGE SUBTOTAL				5,446

*Rad Exposure = Labor x 30%

CLEAN VAULTS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*25,864*	*7,759*	*1*	*7,759*
Access Vault Top (1.3.2.1)	*11,456*	*3,437*	*1*	*3,437*
Tank Vault Access Holes (1.3.3.1)	*12,276*	*3,683*	*1*	*3,683*
Vault Cleaning (1.3.4.1)	*880*	*264*	*5*	*1,320*
Shielding (1.3.5)	*1,760*	*528*	*1*	*528*
Vault Internal Washdown (1.3.6)	*29,040*	*8,712*	*1*	*8,712*
Mechanical (1.3.15)	*3,960*	*1,188*	*1*	*1,188*
Temporary Power (1.3.16.1)	*10,560*	*3,168*	*1*	*3,168*
Camera & Lighting (1.3.16.2)	*1,760*	*528*	*5*	*2,640*
Rad Monitoring System (1.3.16.3)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*25,439*

**Rad Exposure = Labor x 30%*

FILL VAULT WITH CLEAN GROUT - TANK EMPTY

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*14,558*	*4,367*	*1*	*4,367*
Vault & Tank Grouting(1.3.3.2)	*15,226*	*4,568*	*1*	*4,568*
Grout Delivery Piping(1.3.15.1)	*1,079*	*324*	*1*	*324*
Tank Leak Monitor/Vent.(1.3.15.2)	*1,540*	*462*	*1*	*462*
DOSAGE SUBTOTAL				*9,721*

**Rad Exposure = Labor x 30%*

RBCC SUBTOTAL = 5,953 + 1980 + 115,332 + 81,324 + 5,446 + 25,439 + 9,721 = 245,195 mRem

CLASS C GROUT IN TANK VOIDS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	20,933	6,280	1	6,280
Concrete (1.3.3)				
Load Distribution	6,000	1,800	1	1,800
Grout Delivery, Shielding, Cleaning	22,560	6,768	5	33,840
Mechanical(1.3.15)				
Pipe Installation	8,400	2,520	1	2,520
Pipe Removal, Handling, Disposal	18,905	5,672	5	28,358
Electrical (1.3.16)	3,960	1,188	5	5,940
DOSAGE SUBTOTAL				78,737

**Rad Exposure = Labor x 30%*

TOTAL DOSAGE

Major Activity	*Major Subtotal*
Site Preparation	5,953
Characterization	1,980
Tank Isolation	115,332
Wash Interior Tank Walls	81,324
Stabilize Remaining Heel	5,446
Clean Vault	25,439
Fill Vault With Clean Grout, Tank Empty	9,721
Class C Grout in Tank Voids	78,737
TOTAL DOSAGE	323,932 mRem

Total calculated dosage = 323,932 mRem = 323.9 Rem

D&D period = 19 years.

Average number of workers per year = 14.8

Therefore,

Average annual worker radiation dose (Rem/yr) = 323.9/19/14.8 = 1.15 Rem/yr

Heavy Equipment	
Equipment used:	Cement trucks, backhoes, cranes, front-end loaders, graders
These are the principal pieces of heavy equipment that will be used.	
Trips:	2,192 round trips (10 miles/round trip between CFA andICPP)

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours spent by the cement trucks on the road between the Central Facility Area (CFA) and ICPP is calculated below.

It is assumed that the grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.

STABILIZE REMAINING HEEL

Cement Truck Travel Usage

73 yd³/tankx 11 tanks x1 truck/10 yd³ x 1 hour travel/truck = ...80 hrs

FILL VAULT WITH CLEAN GROUT

Cement Truck Travel Usage

[21,080 yd³ + 44 yd³("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd³ x 1 hour travel/truck = ...2,112hrs

TOTAL TRAVEL HOURS = 80 + 2,112 = 2,192 hrs

TOTAL TRIPS = 2,192 travel hoursx1 round trip/travel hour =2,192 round trips between CFA and ICPP (round trips are approximately 10 miles, i.e., 5 miles in each direction).

Hours of Operation:	26,700

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours that heavy equipment operates is shown below.

HEAVY EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,785 + 410 + 3,695 + 2,080 + 2,990 = 16,086 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864= 4,807 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

TOTAL HOURS OPERATION = 16,086 + 4,807 + 5,852=26,745 hours

Acres Disturbed

New:	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous:	2.6 acres in the Tank Farm Facility

Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'.Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'.

Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft² x 1 acre/43,560 ft² = 2.56 acres

Revegetated:	None

Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.

Air Emissions

Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)

This information comes from EDF-TFC-043.The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year.Refer to the EDF for the complete listing and associated release rates of the individual radionuclides.

Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year):	900

The main source of emissions will be from heavy equipment fuel combustion. See spreadsheet for more info.

Effluents	
Type:	Mixed Waste
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500

The first waste stream is produced by adding water to the heel remaining in the waste storage tanks.The next stream is from flushing decontamination solution through the waste transfer piping and then flushing the tank cooling coil lines three times with water.

Activity	*Waste Type*	*Volume (gal)*	*# Tanks*	*Total Waste (gal)*	*Total Waste (liters)*
Adjust Heel pH	*Mixed*	*52,800*	*11*	*580,800*	*2,198,560*
Decon Transfer Piping	*Mixed*	*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines	*Hazardous*	*21,000*	*8*	*21,000*	*79,493*
MIXED WASTE VOLUME =				*745,800*	*2,823,151*
HAZARDOUS WASTE VOLUME =		*21,000*		*21,000*	*79,493*
TOTAL EFFLUENT WASTE VOLUME =				*766,800*	*2,902,645*

Solid Wastes	
Type:	Industrial
Quantity (m^3):	115

The wastes listed below are from the sprung structure, the footings for the foundation, and items from the temporary Ventilation Off Gas system used during closure.

Item	*Dimensions*	*Quantity*	*Total Waste(yd³)*	*Total Waste(m³)*
Sprung Structure	*55,000 ft²*			
BLDG Supports	*6"X6" X 400'*	*25*	*92.6*	*70.8*
BLDG Supports	*6'X6"X 100'*	*20*	*18.5*	*14.2*
Footings	*250 'X 2 ' X 1 '*	*2*	*37.0*	*28.3*
VOG Sled			*1.0*	*0.8*
VOG Duct	*4" X 400 '*		*1.3*	*1.0*
Total Solid Waste Vol.=			*150.4*	*115.0*

Radioactive Wastes	
Type:	Mixed
Quantity (m³):	2,060
Activity (Ci):	570

During closure the tanks will be isolated requiring a temporary line being installed to an adjacent valve box, for pumping the adjusted heel out of the tank being closed to the heel receiver tank. Class C grout will require piping be set in place and remain until the tanks are filled.

The following assumptions were made when determining radioactive waste quantities:

1. *The radioactive waste of concern is waste that is generated during D&D that will require treatment outside of the facility such as PPE or HEPA filters.*
2. *Equipment such as the submersible pumps and mixing pumps and piping that is contaminated during D&D activities will be left behind in the tanks.*
3. *Contaminated temporary transfer lines will also be left behind in the tanks.*
4. *Per Mac McCoy, 1-27-98, a HEPA filter with 500 mRem will have a count of 0.3 curies and a bag full of PPE (5 anti-Cs per bag) will have a count of 0.001 curies.*

Item	*Dimensions*	*Quantity*	*Total Waste(yd³)*	*Total Waste(m³)*
HEPA Filters	*2' x 2' x 1'*	*44*	*6.5*	*5.0*
Personal Protective Equipment	*1' x 1' x 1'*	*72,000*	*2,666.7*	*2,038.7*
Class C Grout delivery piping	*4" x 6000'*		*19.4*	*14.8*
Total Radioactive Waste Volume			*2,692.6*	*2,058.5*

PPE Quantity= 10 workers x 2/day x 225 days/yr x 16 yrs = 72,000 PPEs

HEPA Filter = 0.3 Ci/filter (assuming 500 mRem at contact) =0.3 x 44= 13.2 Ci

PPE Ci = 0.001 Ci/bag (2 mR/bag) = 0.001 x 72,000/5 = 14.4 Ci

Volumes of LLW grout that will be produced from the various categories of waste was obtained from the "TRU Separations Options Scoping Study Report", INEEL/EXT-97-01428, December 1997. These volumes are shown in the table below. Also shown in the table are expected curie activities for the Sodium-Bearing, Alumina, and Zirconia LLW grout. These values were obtained from EDF-TFC-039 (Table 3) and represent the combined activities of Cs-137 and Sr-90. These two radionuclides are the largest contributors to curie activity.

Type Waste	Volume (m^3)	Vol. %	Ci/m^3	Vol % * Ci/m^3
Sodium Bearing	2,992	0.132	107	14.1
Alumina	7,240	0.319	1300	415.2
Zirconia	12,439	0.549	900	493.8
Total Ci/m^3 =				923.1

Fractional amounts of the waste were calculated to determine the average Ci/m^3 that may be expected from the LLW grout. The average value calculated was 923.1 Ci/m^3.

This option uses 6,000 ft of piping that will be set and remain in place until the tanks are filled with Class C grout. The following are calculations used to determine the Curies that will remain in the piping at completion of grouting. Assumed a 4-inch diameter piping and a residue of 1 mm will remain on the inside of the piping.

Piping Circumference = $\pi d = \pi (4/12) = 1.05$ft 6,000 ft of pipe 1mm of residue=0.0033 ft.

Volume of residue = 1.05 ft x 6,000 ft x .0033 ft = 20.7 ft^3 = 0.585 m^3

Total Curies = m^3 x Ci/m^3 0.585 m^3 x 923.1 Ci/m^3 = 540.3 Ci

Hazardous/Toxic Chemicals	
Type:	Nitric Acid
Storage/Inventory:	18,900
Type:	Aluminum Nitrate
Storage/Inventory:	18,900

The following chemicals may possibly be used for the decontamination activities

Item	Chemicals	Molarity	Inventory
Decontamination Solution	AL Nitrate	0.5 molar	5,000 (gal)
Decontamination Solution	Nitric Acid	6 molar	5,000 (gal)
Cooling Water Additive	Potassium Dichromate		21,000 (gal)

Pits/Ponds Created (m^2):	37

Cement Truck wash down pit 20'X 20'=400 ft^2 400 ft^2 = 37.2 m^2

Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)

The water used is for rinsing the solids from the sides of the tanks, flushing the waste transfer piping three times. Flushing the cooling water lines three times (7000 gals each time). Grout truck clean up after delivering load. Flushing the grout piping with water between pigs using compressed air, and adding water to tanks for pH adjustment (from Table 8-2, ICPP Farm Closure Study 90 % Draft; 01204, January 1998.).

SUPPORTING DATA & CALCULATIONS – OPTION 2

Activity	*Trucks*	*Water/ Tank (gal)*	*# Tanks*	*Total Water (gal)*	*Total Water (liters)*
Wash Tank Interior		*15,000*	*11*	*165,000*	*624,591*
Decon Transfer Piping		*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines		*21,000*	*8*	*21,000*	*79,493*
Grout truck cleaning	*2,192*	*5*	*11*	*10,960*	*41,488*
Clean Grouting Equip.		*2*	*11*	*22*	*17*
Water Spray (Dust Control)		*3000*	*11*	*33,000*	*25,229*
Heel pH Adjustment		*39,000*	*11*	*429,000*	*327,971*
TOTAL WATER VOLUME =				*823,982*	*1,723,379*

Energy Requirements	
Electrical (MWh/yr):	1,150

The following assumptions were made when determining the electrical energy requirements:

1. *A "Sprung Structures" will be installed that requires lighting, heating, and ventilation.*
2. *The area that the Sprung Structure covers will be approximately 55,000 ft^2. The average height of the structure is estimated to be approximately 40', the cubic footage would be about 2,200,000 ft^3.*
3. *There will be 1 air change per hour in the Sprung Structure. The ventilation blower would have to move approximately 36,700 cfm of air.*
4. *The ventilation system will require three 7.5 HP blower motors that operate continuously. By comparison, the Type 2 storage buildings at RWMC have 7.5 HP blower motors that move about 14,000 cfm for an air change of one/hr.*
5. *The average lighting in the Sprung Structure will be 1.75 watts/ft^2 (per EDF-VWO-005, Electrical Requirements for the Vitrification Facility). The lights will be on 24 hrs/day.*
6. *The tank mixer will require a 60 HP motor based on the mixer motor used in the Kaiser Study, Conceptual Design Report, Tank Farm Heel Removal Project, RPT-034).*
7. *The mixer will operate for 7 days per tank.*
8. *Steam heat exchangers will be used for heating the Sprung Structure (i.e., electrical power will not be used for heating).*
9. *Evaporative cooling will be used to cool the Sprung Structure (i.e., air-conditioning equipment with compressors will not be used).*
10. *The motors will operate at a 75% efficiency. Therefore, 1 HP will require 1 KW of electrical power.*
11. *A 10% contingency will be added to account for incidental loading such as contruction trailer lighting and ventilation, hand tools, submersible pump, etc.*

ELECTRICAL LOADS

Load Type	*KW(=HP)*	*# of motors*	*total ft^2*	*watts/ft^2*	*days/year*	*hrs/yr**	*KW-Hrs/yr*	*MW-Hrs/yr*
Lighting(Sprung)			*55,000*	*1.75*	*365*	*8,760*	*843,150*	*843.2*
Mixer Motor	*60*	*1*				*97*	*5,836*	*5.8*
Blower Motors	*7.5*	*3*			*365*	*8,760*	*197,100*	*197.1*
SUBTOTAL								**1,046.1**
10% Contingency								*104.6*
TOTAL ELECTRICAL DEMAND								**1,150.7**

**For the mixer motors, hrs/yr =1 mixer/tankx11 tanksx 7 days/mixerx 24 hrs/day ÷ 19 years*

Fossil fuel (liters):	665,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, cranes, cement trucks, work trucks, grout pumps, etc.). Below are assumptions upon which fuel consumption is based.

6. *The number of hours that fossil fuel burning equipment will be used for activities such as site preparation was estimated by multiplying the number of labor hours by 25%, i.e.,*

Equipment Usage (hrs) = Activity Labor Hours x 25%

Crane Support hours are taken at 100% of the Labor Hours, i.e.,

Crane Usage = Crane Support Hours x 100%

7. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment". Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates. Average fuel consumption rates are shown below. Photocopies of applicable pages from the reference guide are included as an attachment.*

Crane Usage = <u>4.65 gal/hr</u>

Average for Earth-Moving Equipment = <u>3.69 gal/hr</u>

Backhoe = 2.45 gal/hr

Front-end loader = 4.03 gal/hr

Grader = 4.31 gal/hr

Average fuel consumption = (2.45 + 4.03 + 4.31)/3 = 3.69 gal/hr

Cement Truck = <u>9.80 gal/hr</u>

Grout Pump = <u>7.14 gal/hr</u>

8. *A Ready-Mix cement truck holds approximately 10 yds^3.*
9. *The grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles. The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.*
10. *The time to unload the cement trucks at the tanks is based on cost estimates in Volume III of the Tank Farm Closure Study.*
11. *73 yds^3 of grout/cement will be required to fill the tank to a 12" depth.*
12. *D&D activities begin with Site Preparation in 2005 and conclude with filling the tank voids with Class C Grout in 2024 for a total of <u>19 years</u>.*

Equipment usage hours for the tasks are shown below.

SITE PREPARATION

Activity	*Total Labor (hrs)*	*Equipment Usage (hrs)*
General Conditions (1.3.1) Crane Support	*800*	*800 x 100% = 800*
Utility Earthwork (1.3.2.1)	*1,850*	*1,850 x 25% = 463*
Special Construction (1.3.13)	*1,200*	*1,200 x 25% = 300*

TANK ISOLATION

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)2,3262,326 x 100% = 2,326
Crane Support

Isolate Tank Lines(1.3.2.3)2,9602,960 x 25%=740

WASH INTERIOR TANK WALLS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,7853,785 x 100% = 3,785
Crane Support

Access Tank Risers(1.3.2.1) 1,7601,760 x 25% = 440

STABILIZE REMAINING HEEL

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 410410 x 100% = 410
Crane Support

Heel Solidification(1.3.3.3)
Place Wet Grout400400 x 25% = 100
Place Dry Grout110110 x 25% = 28

Cement Truck Travel Usage
73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour travel/truck = ...80 hrs

(Note: 1 hour travel/truck includes transit time between CPP and the CFA batch plant along with the time to load the truck with 10 yd^3 of cement)

Grout Pump Usage – assume same time as it takes to place wet grout .... 100 hrs

CLEAN VAULTS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,6953,695 x 100% = 3,695
Crane Support

Access Vault Top for11,456 11,456 x 25% = 2,864
Core Drills(1.3.2.1)

FILL VAULTWITH CLEAN GROUT – TANK EMPTY

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,080 2,080 x 100% = 2,080
Crane Support

Vault and Tank Grouting(1.3.3.2)
Grout Placement, Cleanup 13,070 13,070 x 25% = 3,268
Grout Over Tank Monitor Feet1,056 1,056 x 25% = 264

Cement Truck Travel Usage
[21,080 yd^3 + 44 yd^3 ("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd^3 x 1 hour travel/truck = ...2,112hrs

Grout Pump Usage – assume same time as it takes to place wet grout (3,268 + 264) 3,532hrs

CLASS C GROUT IN TANK VOIDS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,990 2,990 x 100% = 2,990
Crane Support

EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,785 + 410 + 3,695 + 2,080 + 2,990 = 16,086 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864= 4,807 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

Grout Pump = 100 + 3,268 + 264 = 3,632 hrs

Equipment	*Equip. Usage (hrs)*	*Fuel Use Rate (gal/hr)*	*Fuel Usage (gal)*	*Fuel Usage (liters)*
Crane Support	*16,086*	*4.65*	*74,800*	*283,118*
Earth-Moving	*4,807*	*3.69*	*17,738*	*67,138*
Cement Truck	*5,852*	*9.80*	*57,350*	*217,068*
Grout Pump	*3,632*	*7.14*	*25,932*	*98,154*
TOTAL FUEL USAGE			*175,820*	*665,478*

FUEL USAGE/YEAR = 665,478 liters/19 years = 35,025 liters/year

Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Stormwater Pollution Prevention Plan (SWPPP)

The information for the permits necessary for Option 2 was taken from Section 4, Table 4.1 of the 90% Draft Report. Table 4.1 was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill.

Remaining Radioactive Material	
Quantity (m^3):	15,600 (LLW grout deposited in tank voids)
Curies:	14,400,000

Remaining radioactive waste after the Tank Farm Facility has been closed will come from several sources:

1. *Residual waste left behind after the tanks have been washed*
2. *LLW grout that has been deposited in the tank voids*

__Calculate Remaining Waste Volume and Expected Curies__

The residual waste left behind for RBCC should be negligible in comparison to the waste resulting from the LLW grout that is deposited in the tank voids. Therefore, only the waste from the LLW grout will be considered when estimating the quantity and curies remaining after the Tank Farm Facility is closed.

Cesium-137 and Strontium-90 will contribute the most to curie count in the LLW grout. Per EDF-TFC-039, the following curie concentrations are given for alumina calcine, zirconia calcine, and sodium-bearing waste:

__Sodium-Bearing Waste__

Sr-90 = 52 ci/m^3
Cs-137 = 55 ci/m^3

__Alumina Calcine__

Sr-90 = 620 ci/m^3
Cs-137 = 680 ci/m^3

__Zirconia Calcine__

Sr-90 = 510 ci/m^3
Cs-137 = 390 ci/m^3

The "TRU Separations Options Scoping Study Report" (INEEL/EXT-97-01428) estimates the volumes of LLW grout resulting from sodium-bearing waste, alumina calcine, and zirconia calcine. The volumes for each category are:

Sodium-Bearing Waste = 2,992 m^3

Alumina Calcine = 7,240 m^3

Zirconia Calcine = 12,439 m^3

Adding the 3 waste categories together yields a volume = 22,671 m^3

To find out the average curie count for the waste, fractions of the waste total are multiplied by their respective curie concentration, that is,

Curie/m^3 = (2,992/22,671) x (52+55) + (7,240/22,671) x (620 + 680) + (12,439/22,671) x (510 + 390) = 923 Curies/m^3

Per EDF-TFC-029, the combined volume of the 11 tanks = 20,436 yd^3 = 15,625 m^3

Assuming that the tanks are filled completely with LLW grout,

15,625 m^3 x 923 Curies/m^3 = 14,421,447 Curies of waste remaining in the TFF

As stated above, the volume of LLW grout in the tank = 15,625 m^3.

Remaining Hazardous Material:	Negligible

The hazardous material remaining behind after Risk-Based Clean Closure will be negligible as the tanks will have been thoroughly washed and rinsed, the waste transfer lines will be decontaminated, and the vaults will have been cleaned.

Estimate of Diesel Engine Emissions
Tank Farm Closure
- Option 2 -

Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O2, 79% N2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: C9H18 + 13.5O2 —>9CO2 + 9H2O					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NOx = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				35,025	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				69,350	
Total Lbs. of Fuel Used				**69,350**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				550	
Total Lb-Moles of Fuel (as C9H18)				**550**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				1,733,738	
Total Lbs. of Air Added				**1,733,738**	
Lb-Moles of Air for Combustion Fuel				-	
Lb-Moles of Air for Operations Fuel				-	
Lb-Moles of Air for D&D Fuel				**59,784**	
Total Lb- Moles of Air				**59,784**	
Grand Total of Materials Fed, Lbs.				***1,803,087***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		

Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		215,776	108	4,904	1,760,536
H2O		88,272	44	4,904	1,760,536
O2		166,357	83	5,199	1,866,315
N2		1,322,423.22	661	47,229	16,955,355
Subtotal of Major Gases		**1,792,828**	**896**	**62,236**	**22,342,743**
SO2		1,344	0.7		
Particulates		246	0.1		
CO		4,357	2.2		
NOx (assumed NO)		3,734	1.9		
Unburned Hydrocarbons		784	0.4		
Subtotal of Contaminants		**10,465**	**5**		
Major Gases and Contaminants - Total			**902**	**Tons**	

Table 3. Project data sheet for Tank Farm Closure – Option 3 (RBCC, CERCLA Fill)

Generic Information	
Description/Function	Tank Farm Closure – Option 3 (Risk-Based Clean Closure, CERCLA Fill)
This is the title of the project data sheet	
EIS Alternative	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW), CERCLA Waste
Per explanation on page C-1 ("Technical Data Requirements for the INEEL High-Level Waste and Facilities Disposition EIS", Halliburton NUS Corp., Nov. 14, 1997) and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "Environmental Restoration". ***The waste stream should be mixed low-level waste after the heel has been diluted with water during pH adjustment and tank washdown. The tank voids will then be subsequently filled with CERCLA Waste, which is assumed to be LLW.***	
Action Type	D&D on existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the tank farm will be erected .
Relevant structures are the 11 underground storage tanks and vaults. A temporary weather enclosure such as a Sprung Structure will be installed to allow year-round closure work in the tank farm.	
Size (m^2)	10,400
Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'. Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'. ***Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2= 10,373 m^2***	
Other Features (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup.	
Location	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL

The Tank Farm Facility is located at ICPP

Candidate for Privatization?	No

The work to be performed is D&D in nature and does not involve construction and operation of a facility.

Construction Information	
Cost ($):Preconstruction	$46,900,000

Regulatory Compliance	$18,100,000
Design	22,000,000
Proof of Process/ORR	6,800,000
Total PreConstruction	**$46,900,000**

Preconstruction costs cited above are from the Option 3 cost estimates (Jan. 22, 1998).

Regulatory Compliance costs include: Air Permitting, Air Monitors, RCRA Closure Plan, Project Management, G&A Adders, etc.,

Also included in Regulatory Compliance costs are activities for Regulatory Affairs Oversight.Although these activities will be ongoing throughout the D&D process and perhaps should be placed with the D&D costs, it would be confusing to extract these costs from this section and place them on the construction side of the cost equation.The oversight costs (without adders and contingency) are about $281,000 and represent a small portion of the overall costs.

Cost ($):Construction/D&D	

Site Preparation	$11,400,000
Characterize Heel	4,600,000
Tank Isolation	10,200,000
Wash Interior Tank Walls	33,000,000
Solidify Remaining Heel	12,400,000
Clean Vaults	21,900,000
Fill Vault Voids with Clean Grout	13,500,000
Fill Tank Voids with CERCLA Soil	56,900,000
Total Construction/D&D	**$163,900,000**

Construction costs cited above are from the Option 3 cost estimates (Jan. 22, 1998).

Schedule Start/End:Preconstruction	
Regulatory Compliance	2000 – 2029
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006

Schedule dates are from the Option 3 cost estimates (Jan. 22, 1998).

NOTE:From this point, the following data is based on the 90% Review cost estimates (where applicable).

Schedule Start/End:Construction	
Site Preparation	2004 – 2013
Characterize Heel	2001– 2017
Tank Isolation	2006 – 2013
Wash Interior Tank Walls	2006 – 2016
Solidify Remaining Heel	2008 – 2018
Clean Vaults	2011 – 2020
Fill Vault Voids with Clean Grout	2013 – 2021
Fill Tank Voids with CERCLA Soil	2022 – 2030
Schedule dates are from the Option 3 cost estimate (Jan. 22, 1998).	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 11.4
New:	1.1
Existing:	10.3
Radiation:	11.4 (includes all employees)

SUPPORTING DATA & CALCULATIONS – OPTION 3

Several assumptions were made to determine the estimated number of workers required.

The assumptions are:

15. *Estimates are given for the average number of workers per year required to complete TFF closure.*
16. *The average number of workers per year is based on D&D activities that begin with Site Preparation in 2004 and conclude with tank and vault grouting in 2020 for a total of 16 years.*
17. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97).This ratio assumes a 10% worker turnover rate.*
18. *Subcontract labor hours = (Total Subcontract Cost – G&A,PIF)*0.55/($33/hr)*
19. *Total number of construction labor hours = Total labor hours + (Total Subcontract Cost – G&A,PIF) *0.55/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
20. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
21. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	Hours
Site Preparation	22,191
Tank Isolation	69,871
Wash Interior Tank Walls	112,689
Stabilize Remaining Heel	12,252
Clean Vaults	109,986
Fill Vault Voids	61,914
CERCLA Soil in Tank Voids	79,663
SUBTOTAL HOURS	468,566

SUBCONTRACT HOURS

Activity	Total S/C ($)	G&A,PIF($)	S/C -G&A/PIF ($)	Hours*
Site Preparation	1,232,273	480,905	751,368	12,523
Characterization	1,293,514	303,514	990,000	16,500
Tank Isolation	188,922	173,922	15,000	250
Wash Interior Tank Walls	1,739,361	1,519,361	220,000	3,667
Stabilize Remaining Heel	467,680	467,680	0	0
Clean Vaults	624,249	624,249	0	0
Fill Vault Voids	1,237,213	1,237,213	0	0
CERCLA Soil in Tank Voids	3,305,878	1,482,878	1,823,000	30,383
SUBTOTAL HOURS				63,323

**Subcontract labor hours calculated per Assumption #5 formula.*

Total Labor Hours = 468,566 + 63,323= 531,889 hours

D&D Time Period= 26 years (2004 – 2030)

Average Number of Employees per Year = 531,889/26/1800

= 11.4Employees/Year

#of existing workers per year=11.4 x 90% =10.3 existing workers per year

#of new workers per year=11.4 x 10%=1.1 new workers per year

Average annual worker radiation dose (Rem/yr)	0.95 Rem/yr

The following assumptions were made when calculating the average worker radiation dose per year.

4. *For activities where radiation exposure is expected, the estimated # of hours worked in radiation fields will be 30%of the total time estimated for those activities (per conversation with Mac McCoy on 12-17-97).*
5. *Average radiation dose rates for TFF Closure are given in EDF-TFC-041.*
6. *The average yearly worker radiation dose is based on a 26-year time frame that begins with Site Preparation in 2004 and concludes with filling the tank voids with CERCLA soil in 2030 for a total of 26 years.*

Calculations for dosage rates are presented below.The numbers in parentheses are code designators from the Tank Farm Closure Study cost estimates.

SITE PREPARATION

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	5,605	1,682	1	1,682
Utility Earthwork (1.3.2.1)	1,850	555	1	555
Special Construction(1.3.13)	1,200	360	1	360
Utilities (1.3.15.1)	950	285	1	285
VOG Installation/Removal(1.3.15.2)	5,129	1,539	1	1,539
Temporary Power Hookup(1.3.16.2)	5,108	1,532	1	1,532
DOSAGE SUBTOTAL				5,953

**Rad Exposure = Labor x 30%*

CHARACTERIZATION

ActivityDose Rate(mR/hr)Exposure Time(man-hrs)Dosage(mR)

Characterize Heel(1.3.1)10 3 rad workers x 1 hour/sample1980 x 66 samples = 198 man-hrs _____

DOSAGE SUBTOTAL1980

TANK ISOLATION

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	16,294	4,888	1	4,888
Isolate Tank Lines(1.3.2.3)	2,960	888	1	888
Tank Line Isolation(1.3.15.2)	18,972	5,692	1	5,692
Tank Line Isolation(1.3.15.2)	10,725	3,218	30	96,525
VOG System(1.3.15.3)	4,840	1,452	5	7,260
Tank Elec./Inst. Isolation(1.3.16.1)	264	79	1	79
DOSAGE SUBTOTAL				115,332

**Rad Exposure = Labor x 30%*

WASH INTERIOR TANK WALLS

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	26,496	7,949	1	7,949
Access Tank Risers(1.3.2.1)	1,760	528	5	2,640
Heel Mixing & Removal(1.3.4.2)	1,760	528	1	528
Heel Mixing & Removal(1.3.4.2)	5,280	1,584	5	7,920
Shielding(1.3.6)	1,760	528	5	2,640
Tank Internal Washdown(1.3.7)	5,280	1,584	1	1,584
Tank Internal Washdown(1.3.7)	16,500	4,950	5	24,750
Equipment Removal(1.3.11.1)				
Remove Jets, Corrosion Coupons	7,040	2,112	5	10,560
Set Up/Remove Rad Tent	7,040	2,112	1	2,112
Cut & Box Removed Equipment	3,520	1,056	5	5,280
Heel Transfer Lines(1.3.15.1)				
Valve Box Tie-In	880	264	30	7,920
Rad Tent, Transfer Line	5,885	1,766	1	1,766
Temporary Power(1.3.16.1)	7,920	2,376	1	2,376
Camera & Lighting(1.3.16.2)	1,760	528	5	2,640
Rad Monitoring System(1.3.16.3)	2,200	660	1	660
DOSAGE SUBTOTAL				81,324

*Rad Exposure = Labor x 30%

SOLIDIFY REMAINING HEEL

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	2,874	862	1	862
Heel Solidification(1.3.3.3)				
Install/Remove Mounting Frames	2,640	792	1	792
Install/Remove Temp. Shielding	1,760	528	5	2,640
Place Wet/Dry Grout	510	153	1	153
Grout Delivery Piping(1.3.15.5)	1,128	338	1	338
Temporary Power(1.3.16.1)	2,200	660	1	660
DOSAGE SUBTOTAL				5,446

*Rad Exposure = Labor x 30%

CLEAN VAULTS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*25,864*	*7,759*	*1*	*7,759*
Access Vault Top (1.3.2.1)	*11,456*	*3,437*	*1*	*3,437*
Tank Vault Access Holes (1.3.3.1)	*12,276*	*3,683*	*1*	*3,683*
Vault Cleaning (1.3.4.1)	*880*	*264*	*5*	*1,320*
Shielding (1.3.5)	*1,760*	*528*	*1*	*528*
Vault Internal Washdown (1.3.6)	*29,040*	*8,712*	*1*	*8,712*
Mechanical (1.3.15)	*3,960*	*1,188*	*1*	*1,188*
Temporary Power (1.3.16.1)	*10,560*	*3,168*	*1*	*3,168*
Camera & Lighting (1.3.16.2)	*1,760*	*528*	*5*	*2,640*
Rad Monitoring System (1.3.16.3)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*25,439*

**Rad Exposure = Labor x 30%*

FILL VAULT WITH CLEAN GROUT - TANK EMPTY

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*14,558*	*4,367*	*1*	*4,367*
Vault & Tank Grouting(1.3.3.2)	*15,226*	*4,568*	*1*	*4,568*
Grout Delivery Piping(1.3.15.1)	*1,079*	*324*	*1*	*324*
Tank Leak Monitor/Vent.(1.3.15.2)	*1,540*	*462*	*1*	*462*
DOSAGE SUBTOTAL				*9,721*

**Rad Exposure = Labor x 30%*

RBCC SUBTOTAL = 5,953 + 1980 + 115,332 + 81,324 + 5,446 + 25,439 + 9,721 = 245,195 mRem

CERCLA SOIL IN TANK VOIDS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*20,718*	*6,215*	*1*	*6,215*
Sitework (1.3.2)	*11,610*	*3,483*	*5*	*17,415*
Conveying Systems (1.3.14)	*39,867*	*11,960*	*1*	*11,960*
DOSAGE SUBTOTAL				*35,591*

Rad Exposure = Labor x 30%

TOTAL DOSAGE

Major Activity	*Major Subtotal*
Site Preparation	*5,953*
Characterization	*1,980*
Tank Isolation	*115,332*
Wash Interior Tank Walls	*81,324*
Stabilize Remaining Heel	*5,446*
Clean Vault	*25,439*
Fill Vault With Clean Grout, Tank Empty	*9,721*
CERCLA Soil in Tank Voids	*35,591*
TOTAL DOSAGE	**280,786 mRem**

Total calculated dosage = 280,786 mRem = 280.8 Rem

D&D period = 26 years.

Average number of workers per year = 11.4

Therefore,

Average annual worker radiation dose (Rem/yr) = 280.8/26/11.4 = 0.95 Rem/yr

Heavy Equipment	
Equipment used	Cement trucks, backhoes, cranes, front-end loaders, graders
These are the principal pieces of heavy equipment that will be used.	
Trips	2,192

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours spent by the cement trucks on the road between the Central Facility Area (CFA) and ICPP is calculated below.

It is assumed that the grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.

STABILIZE REMAINING HEEL

Cement Truck Travel Usage

73 yd³/tankx 11 tanks x1 truck/10 yd³ x 1 hour/truck = ...80 hrs

FILL VAULT WITH CLEAN GROUT

Cement Truck Travel Usage

[21,080 yd³ + 44 yd³ ("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]

x 1 truck/10 yd³ x 1 hour/truck = ...2,112hrs

TOTAL HOURS = 80 + 2,112 = 2,192 hrs

TOTAL TRIPS = 2,192 hrsx1 round trip/hour =2,192 round trips between CFA and ICPP (round trips are approximately 10 miles, i.e., 5 miles in each direction).

Hours of Operation	32,800

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours that heavy equipment operates is shown below.

HEAVY EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,785 + 410 + 3,695 + 2,080 + 5,180 = 18,276 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,902 + 1000 = 8,709 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

TOTAL HOURS OPERATION = 18,276 + 8,709 + 5,852=32,837 hours

Acres Disturbed	
New	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous	2.6 acres in the Tank Farm Facility

Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'.Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'.

Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft² x 1 acre/43,560 ft² = 2.56 acres

Revegetated	None

Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.

Air Emissions	
Type:	Radionuclides

Quantity (Curies/year)	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)

This information comes from EDF-TFC-043.The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year.Refer to the EDF for complete listing and release rates of the individual radionuclides.

Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year):	750

The main source of emissions will be from heavy equipment fuel combustion. See Spreadsheet for more info.

Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500

Adding water to heel remaining in the waste storage tanks and pumping out produces the first waste stream.The next stream is from flushing decontamination solution through the waste transfer piping and then flushing the tank cooling coil lines three times with water.

Activity	*Waste Type*	*Volume (gal)*	*# Tanks*	*Total Waste (gal)*	*Total Waste (liters)*
Adjust Heel pH	*Mixed*	*52,800*	*11*	*580,800*	*2,198,560*
Decon Transfer Piping	*Mixed*	*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines	*Hazardous*	*21,000*	*8*	*21,000*	*79,493*
MIXED WASTE VOLUME =				*745,800*	*2,823,151*
HAZARDOUS WASTE VOLUME =		*21,000*		*21,000*	*79,493*
TOTAL EFFLUENT WASTE VOLUME =				*766,800*	*2,902,645*

Solid Wastes	
Type:	Industrial
Quantity (m^3):	115

The wastes listed below are from the sprung structure, the footings required to position it, and items from the temporary Ventilation Off Gas system used during closure

Item	Dimensions	Quantity	Total Waste(yd^3)	Total Waste(m^3)
Sprung Structure	55,000 ft^2			
BLDG Supports	6"X6" X 400'	25	92.6	70.8
BLDG Supports	6'X6"X 100'	20	18.5	14.2
Footings	250 'X 2 ' X 1 '	2	37.0	28.3
VOG Sled			1.0	0.8
VOG Duct	4" X 400 '		1.3	1.0
Total Solid Waste Vol.=			150.4	115.0

Radioactive Wastes	
Type:	Mixed
Quantity (m^3 and Ci):	2,060
Activity (Ci):	570

During closure the tanks will be isolated requiring a temporary line being installed to an adjacent valve box, for pumping the adjusted heel out of the tank being closed to the heel receiver tank.CERCLA soils will require piping be set in place and remain until the tanks are filled.

The following assumptions were made when determining radioactive waste quantities:

5. *The radioactive waste of concern is waste that is generated during D&D that will require treatment outside of the facility such as PPE or HEPA filters.*
6. *Equipment such as the submersible pumps and mixing pumps and piping that is contaminated during D&D activities will be left behind in the tanks.*
7. *Contaminated temporary transfer lines will also be left behind in the tanks.*

Per Mac McCoy, 1-27-98, a HEPA filter with 500 mRem will have a count of 0.3 curies and a bag full of PPE (5 anti-Cs per bag) will have a count of 0.001 curies.

Item	Dimensions	Quantity	Total Waste(yd^3)	Total Waste(m^3)
HEPA Filters	2' x 2' x 1'	44	6.5	5.0
Personal Protective Equipment	1' x 1' x 1'	72,000	2,666.7	2,038.7
CERCLA Soil delivery piping	4"X6000'		19.4	14.8
Total RadioactiveWaste Vol.=			2692.6	2058.5

PPE Quantity= 10 workers x 2/day x 225 days/yr x 16 yrs = 72,000 PPEs

HEPA Filter = 0.3 Ci/filter (assuming 500 mRem at contact) =0.3 Ci/filter x 44 filter = 13.2 Ci

PPE Ci = 0.001 Ci/bag (assuming 2 mR/bag) = 0.001Ci/bag x 72,000/5 PPE/(PPE/bag) = 14.4 Ci

Because there is no data at the present time for the CERCLA soil grout activity levels, a judgement was made to substitute the LLW grout activity values for Curies calculations

Volumes of LLW grout that will be produced from the various categories of waste was obtained from the "TRU Separations Options Scoping Study Report", INEEL/EXT-97-01428, December 1997.These volumes are shown in the table below.Also shown in the table are expected curie activities for the Sodium-Bearing, Alumina, and Zirconia LLW grout.These values were obtained from EDF-TFC-039 (Table 3) and represent the combined activities of Cs-137 and Sr-90.These two radionuclides are the largest contributors to curie activity.

Type Waste	Volume (m^3)	Vol. %	Ci/m^3	Vol % * Ci/m^3
Sodium Bearing	2,992	0.132	107	14.1
Alumina	7,240	0.319	1300	415.2
Zirconia	12,439	0.549	900	493.8
Total Ci/m^3 =				923.1

Fractional amounts of the waste were calculated to determine the average Ci/m^3 that may be expected from the LLW grout.The average value calculated was 923.1 Ci/m^3.

This option uses 6,000 ft of piping that will be set and remain in place until the tanks are filled with the CERCLA Soil Grout.The following are calculations used to determine the Curies that will remain in the piping at completion of CERCLA Soil Grouting.Assuming 4-inch diameter piping and a residue of 1 mm will remain on the inside of the piping.

Piping Circumference = π d = π (4/12) =1.05ft6,000 ft of pipe 1mm of residue=0.0033 ft.

Volume of residue = 1.05 ft x 6,000 ft x .0033 ft =20.7 ft^3=0.585 m^3

Total Curies = m^3 x Ci/m^3 0.585 m^3 x 923.1 Ci/m^3 = 540.3 Ci.

Hazardous/Toxic Chemicals

Type:	Nitric Acid
Storage/Inventory (liters):	18,900
Type:	Aluminum Nitrate
Storage/Inventory (liters):	18,900

The following chemicals may possibly be used for the decontamination activities

Item	Chemicals	Molarity	Inventory
Decontamination Solution	AL. Nitrate	0.5 molar	5,000 (gal)
Decontamination Solution	Nitric Acid	6 molar	5,000 (gal)
Cooling Water Additive	Potassium Dichromate		21,000 (gal)

Pits/Ponds Created (m^2)	37

Cement Truck wash down pit20'X 20'=400 $ft^2$400 ft^2 = 37.2 m^2

Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)

The water used is for rinsing the solids from the sides of the tanks, flushing the waste transfer piping three times. Flushing the cooling water lines three times (7000 gals each time). Grout truck clean up after delivering load. Flushing the grout piping with water between pigs using compressed air, and adding water to tanks for pH adjustment. (From Table 8-2 ICCP Tank Farm Closure Study 90% Draft INEEL/EXT-97-10204, January 98.)

Activity	*Trucks*	*Water/ Tank (gal)*	*# Tanks*	*Total (gal)*	*Total (liters)*
Wash Tank interior		*15,000*	*11*	*165,000*	*624,591*
Decon Transfer Piping		*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines		*21,000*	*8*	*21,000*	*79,493*
Grout truck cleaning	*2,192*	*5*	*11*	*10,960*	*41,488*
Clean Grouting Equip.		*2*	*11*	*22*	*17*
Water Spray (Dust Control)		*3000*	*11*	*33,000*	*25,229*
Heel pH adjustment		*39,000*	*11*	*429,000*	*327,971*
TOTAL WATER VOLUME =				*823,982*	*1,723,379*

Energy Requirements	
Electrical (MWh/yr)	1,150

The following assumptions were made when determining the electrical energy requirements:

12. *A "Sprung Structures" will be installed that requires lighting, heating, and ventilation.*
13. *The area that the Sprung Structure covers will be approximately 55,000 ft^2. The average height of the structure is estimated to be approximately 40', the cubic footage would be about 2,200,000 ft^3.*
14. *There will be 1 air change per hour in the Sprung Structure. The ventilation blower would have to move approximately 36,700 cfm of air.*
15. *The ventilation system will require three 7.5 HP blower motors that operate continuously. By comparison, the Type 2 storage buildings at RWMC have 7.5 HP blower motors that move about 14,000 cfm for an air change of one/hr.*
16. *The average lighting in the Sprung Structure will be 1.75 watts/ft^2 (per EDF-VWO-005, Electrical Requirements for the Vitrification Facility). The lights will be on 24 hrs/day.*
17. *The tank mixer will require a 60 HP motor based on the mixer motor used in the Kaiser Study, Conceptual Design Report, Tank Farm Heel Removal Project, RPT-034).*
18. *The mixer will operate for 7 days per tank.*
19. *Steam heat exchangers will be used for heating the Sprung Structure (i.e., electrical power will not be used for heating).*
20. *Evaporative cooling will be used to cool the Sprung Structure (i.e., air-conditioning equipment with compressors will not be used).*
21. *The motors will operate at 75% efficiency. Therefore, 1 HP will require 1 kW of electrical power.*
22. *A 10% contingency will be added to account for incidental loading such as construction trailer lighting and ventilation, hand tools, submersible pump, etc.*

ELECTRICAL LOADS

Load Type	KW(=HP)	# of motors	total ft^2	watts/ft^2	days/year	hrs/yr*	KW-Hrs/yr	MW-Hrs/yr
Lighting(Sprung)			55,000	1.75	365	8,760	843,150	843.2
Mixer Motor	60	1				71	4,265	4.3
Blower Motors	7.5	3			365	8,760	197,100	197.1
SUBTOTAL								**1,044.5**
10% Contingency								104.5
TOTAL ELECTRICAL DEMAND								**1,149.0**

**For the mixer motors, hrs/yr. =1 mixer/tank x 11 tanks x 7 days/mixer x 24 hrs/day ÷ 26 years*

Fossil fuel (liters)	759,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, cranes, cement trucks, work trucks, grout pumps, etc.). Below are assumptions upon which fuel consumptions are based.

13. *The number of hours that fossil fuel burning equipment will be used for activities such as site preparation was estimated by multiplying the number of labor hours by 25%, i.e.,*

Equipment Usage (hrs) = Activity Labor Hours x 25%

14. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment". Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates. Average fuel consumption rates are shown below. Photocopies of applicable pages from the reference guide are included as an attachment.*

    Crane Support = <u>4.65 gal/hr</u>

    Average for Earth-Moving Equipment = <u>3.69 gal/hr</u>

    - *Backhoe = 2.45 gal/hr*
    - *Front-end loader = 4.03 gal/hr*
    - *Grader = 4.31 gal/hr*
    - *Average fuel consumption = (2.45 + 4.03 + 4.31)/3 = 3.69 gal/hr*

    Cement Truck = <u>9.80 gal/hr</u>

    Grout Pump = <u>7.14 gal/hr</u>

15. *A Ready-Mix cement truck holds approximately 10 yds^3.*
16. *The grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles. The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.*
17. *The time to unload the cement trucks at the tanks is based on cost estimates in Volume III of the Tank Farm Closure Study.*
18. *73 yds^3 of grout/cement will be required to fill the tank to a 12" depth.*
19. *D&D activities begin with Site Preparation in 2004 and conclude with filling the tank voids with CERCLA soil in 2030 for a total of <u>26 years</u>.*

Equipment usage hours for the tasks are shown below.

SITE PREPARATION

Activity	*Total Labor (hrs)*	*Equipment Usage (hrs)*
General Conditions(1.3.1)	*800*	*800 x 100% = 800*
Crane Support		
Utility Earthwork(1.3.2.1)	*1,850*	*1,850 x 25% = 463*
Special Construction(1.3.13)	*1,200*	*1,200 x 25% = 300*

TANK ISOLATION

Activity	*Total Labor (hrs)*	*Equipment Usage (hrs)*
General Conditions(1.3.1)	*2,326*	*2,326 x 100% = 2,326*
Crane Support		
Isolate Tank Lines(1.3.2.3)	*2,960*	*2,960 x 25%=740*

WASH INTERIOR TANK WALLS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,7853,785 x 100% = 3,785
Crane Support

Access Tank Risers(1.3.2.1) 1,7601,760 x 25% = 440

SOLIDIFY REMAINING HEEL

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 410410 x 100% = 410
Crane Support

Heel Solidification(1.3.3.3)
Place Wet Grout400400 x 25% = 100
Place Dry Grout110110 x 25% = 28

Cement Truck Travel Usage
73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour/truck = ...80 hrs

(Note: 1 hour/truck includes transit time between CPP and the CFA batch plant along with the time to load the truck with 10 yd^3 of cement)

Grout Pump Usage – assume same time as it takes to place wet grout .... 100 hrs

CLEAN VAULTS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,6953,695 x 100% = 3,695
Crane Support

Access Vault Top for11,456 11,456 x 25% = 2,864
Core Drills(1.3.2.1)

FILL VAULTWITH CLEAN GROUT – TANK EMPTY

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,080 2,080 x 100% = 2,080
Crane Support

Vault and Tank Grouting(1.3.3.2)
Grout Placement, Cleanup 13,070 13,070 x 25% = 3,268
Grout Over Tank Monitor Feet1,056 1,056 x 25% = 264

Cement Truck Travel Usage
[21,080 yd^3 + 44 yd^3 ("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd^3 x 1 hour/truck = ...2,112hrs

Grout Pump Usage – assume same time as it takes to place wet grout (3,268 + 264) 3,532hrs

CERCLA SOIL IN TANK VOIDS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 5,180 5,180 x 100% = 5,180
Crane Support

Sitework(1.3.2) 11,61011,610 x 25% = 2,902
Mix and Deliver Soil to Tanks

Special Construction(1.3.13) 240,000 x .55/33 =4,0004,000 x 25% = 1,000

EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,785 + 410 + 3,695 + 2,080 + 5,180 = 18,276 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,902 + 1000 = 8,709 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

Grout Pump = 100 + 3,268 + 264 = 3,632 hrs

Equipment	*Equip. Usage (hrs)*	*Fuel Use Rate (gal/hr)*	*Fuel Usage (gal)*	*Fuel Usage (liters)*
Crane Support	*18,276*	*4.65*	*84,983*	*321,662*
Earth-Moving	*8,709*	*3.69*	*32,136*	*121,636*
Cement Truck	*5,852*	*9.80*	*57,350*	*217,068*
Grout Pump	*3,632*	*7.14*	*25,932*	*98,154*
TOTAL FUEL USAGE			*200,402*	*758,520*

FUEL USAGE/YEAR = 758,520 liters/26 years = 29,174 liters/year

SUPPORTING DATA & CALCULATIONS – OPTION 3

Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm water Pollution Prevention Plan (SWPPP) The CERCLA Program will meet "applicable or relevant and appropriate requirements" (ARARs)
Remaining Radioactive Material:	Current tank data for radioactive material is not available at this time. Waste transfers between tanks are taking place that will affect the concentrations of radioactive material in the tanks.
Remaining Hazardous Material:	Current tank data for hazardous material is not available at this time. Waste transfers between tanks are currently taking place that will affect the concentrations of hazardous material in the tanks.

The information for the permits necessary for Option 3 was taken from Section 4, Table 4.1 of the 90% Draft Report. Table 4.1 was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill. Since CERCLA Waste will be deposited in the tank voids, the CERCLA program will be required to meet ARARs.

Remaining Radioactive Material	
Quantity (m^3):	15,600 (CERCLA Waste deposited in tank voids)
Curies:	46,200

CERCLA Waste will be placed in the tank voids for this option. The assumption is made that the CERCLA Waste that is deposited in the tanks will come from the soils in the TFF and that this will be the sole source of waste.

Asked Rene Rodriguez if there was information about the # of curies in the TFF soils. Rene referred me to a document titled "Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL – Part A, RI/BRA Report (Final)", DOE/ID-10534, November 1997. Table 5-42 on page F5-55 and F5-56 summarizes the known releases of radionuclides in the Tank Farm area. The table also shows the curies for each radionuclide.

Adding up the curies for each radionuclide yields a combined total=46,180 Ci

Table 5-42 is included as an attachment.

Remaining Hazardous Material:	Negligible

The hazardous material remaining behind after Risk-Based Clean Closure will be negligible as the tanks will have been thoroughly washed and rinsed, the waste transfer lines will be decontaminated, and the vaults will have been cleaned.

Estimate of Diesel Engine Emissions
Tank Farm Closure
- Option 3 -

Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O_2, 79% N_2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: $C_9H_{18} + 13.5O_2 \longrightarrow 9CO_2 + 9H_2O$					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NO_x = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				29,174	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				57,765	
Total Lbs. of Fuel Used				**57,765**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				458	
Total Lb-Moles of Fuel (as C_9H_{18})				**458**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				1,444,113	
Total Lbs. of Air Added				**1,444,113**	
Lb-Moles of Air for Combustion Fuel				-	
Lb-Moles of Air for Operations Fuel				-	
Lb-Moles of Air for D&D Fuel				**49,797**	
Total Lb- Moles of Air				**49,797**	
Grand Total of Materials Fed, Lbs.				***1,501,878***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO_2		-	-	-	-
H_2O		-	-	-	-
O_2		-	-	-	-
N_2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO_2		-	-		
Particulates		-	-		

CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		179,730	90	4,085	1,466,435
H2O		73,526	37	4,085	1,466,435
O2		138,567	69	4,330	1,554,544
N2		1,101,509.64	551	39,340	14,122,927
Subtotal of Major Gases		**1,493,332**	**747**	**51,839**	**18,610,340**
SO2		1,119	0.6		
Particulates		205	0.1		
CO		3,629	1.8		
NOx (assumed NO)		3,110	1.6		
Unburned Hydrocarbons		653	0.3		
Subtotal of Contaminants		**8,716**	**4**		
Major Gases and Contaminants - Total			**751**	**Tons**	

Table 4. Project Data Sheet for ICPP Tank Farm Closure – Option 4 (CLFS, LLW Fill)

Generic Information	
Description/Function	Tank Farm Closure – Option 4 (Close to RCRA Landfill Standards, LLW Fill)
This is the title of the project data sheet	
EIS Alternative	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure LLW, Mixed Low-Level Waste (MLLW)
Per explanation on page C-1 ("Technical Data Requirements for the INEEL High-Level Waste and Facilities Disposition EIS", Halliburton NUS Corp., Nov. 14, 1997) and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "Environmental Restoration". ***The waste stream should be mixed low-level waste after the heel has been diluted with water during pH adjustment and tank washdown. The tank voids will then be subsequently filled with LLW grout.***	
Action Type	D&D on existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the tank farm will be erected .
Relevant structures are the 11 underground storage tanks and vaults. A temporary weather enclosure such as a Sprung Structure will be installed to allow year-round closure work in the tank farm.	
Size (m^2)	10,400
Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'. Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'. ***Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2= 10,373 m^2***	
Other Features (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup.	

SUPPORTING DATA & CALCULATIONS – OPTION 4

Location	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
The Tank Farm Facility is located at ICPP	
Candidate for Privatization?	No
The work to be performed is D&D in nature and does not involve construction and operation of a facility.	
Construction Information	
Cost ($):Preconstruction	$32,000,000

Regulatory Compliance	$15,500,000
Design	19,500,000
Proof of Process/ORR	6,800,000
Total PreConstruction	**$41,800,000**

Preconstruction costs cited above are from the Option 4 cost estimates (Jan 22, 1998)).

Regulatory Compliance costs include: Air Permitting, Air Monitors, RCRA Closure Plan, Project Management, G&A Adders, etc.,

Also included in Regulatory Compliance costs are activities for Regulatory Affairs Oversight.Although these activities will be ongoing throughout the D&D process and probably should be placed with the D&D costs, it would be confusing to extract these costs from this section and place them on the construction side of the cost equation.The oversight costs (without adders and contingency) are about $213,000 and represent a small portion of the overall costs.

Cost ($):Construction/D&D	$110,700,000

Site Preparation	$11,500,000
Characterize Heel	2,600,000
Tank Isolation	11,000,000
Wash Interior Tank Walls	32,100,000
Solidify Remaining Heel	11,000,000
Fill Vault Voids with Clean Grout	21,800,000
Fill Tank Voids with Class C Grout	33,600,000
Total Construction/D&D	**$123,600,000**

Construction costs cited above are from the Option 4 cost estimates (Jan 22, 1998).

Schedule Start/End:Preconstruction	
Regulatory Compliance	2000 – 2024
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006

Schedule dates are from the Option 4 cost estimates (Jan. 22, 1998).

NOTE:From this point, the following data is based on the 90% Review cost estimates (where applicable).

Schedule Start/End:Construction	
Site Preparation	2005 – 2006
Characterize Heel	2007 – 2016
Tank Isolation	2007 – 2017
Wash Interior Tank Walls	2007 – 2017
Solidify Remaining Heel	2008 – 2020
Fill Vault Voids with Clean Grout	2010 – 2021
Fill Tank Voids with Class C Grout	2011 – 2024
Schedule dates are from the Option 4 cost estimate (Jan. 22, 1998).	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 11.6
New:	1.2
Existing:	10.4
Radiation:	11.6 (includes all employees)

Several assumptions were made to determine the estimated number of workers required.

The assumptions are:

22. *Estimates are given for the average number of workers per year required to complete TFF closure.*
23. *The average number of workers per year is based on D&D activities that begin with Site Preparation in 2005 and conclude with filling the tanks with LLW grout in 2024 for a total of 19 years.*
24. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97).This ratio assumes a 10% worker turnover rate.*
25. *Subcontract labor hours = (Total Subcontract Cost – G&A/PIF) *0.55/($33/hr)*
26. *Total number of construction labor hours = Total labor hours + (Total Subcontract Cost – G&A,PIF) *0.55/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
27. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
28. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	*Hours*
Site Preparation	*23,391*
Tank Isolation	*69,871*
Wash Interior Tank Walls	*105,667*
Stabilize Remaining Heel	*12,252*
Fill Vault Voids	*61,914*
LLW Grout in Tank Voids	*89,068*
SUBTOTAL HOURS	*362,163*

SUBCONTRACT HOURS

Activity	*Total S/C ($)*	*G&A,PIF($)*	*S/C -G&A/PIF ($)*	*Hours**
Site Preparation	*1,131,405*	*480,905*	*650,500*	*10,842*
Characterization	*1,293,514*	*303,514*	*990,000*	*16,500*
Tank Isolation	*188,922*	*173,922*	*15,000*	*250*
Wash Interior Tank Walls	*1,672,404*	*1,452,404*	*220,000*	*3,667*
Stabilize Remaining Heel	*467,680*	*467,680*	*0*	*0*
Fill Vault Voids	*1,237,213*	*1,237,213*	*0*	*0*
LLW Grout in Tank Voids	*1,939,587*	*1,674,487*	*265,100*	*4,418*
SUBTOTAL HOURS				*35,677*

**Subcontract labor hours calculated per Assumption #5 formula.*

Total Labor Hours = 362,163 + 35,677= 397,840 hours

D&D Time Period= 19 years (2005 – 2024)

Average Number of Employees per Year = 397,840/19/1800

= 11.6Employees/Year

#of existing workers per year=11.6 x 90% =10.4 existing workers per year

#of new workers per year=11.6 x 10%=1.2 new workers per year

Average annual worker radiation dose (rem/yr)	1.38 Rem/yr

The following assumptions were made when calculating the average worker radiation dose per year.

7. *For activities where radiation exposure is expected, the estimated # of hours worked in radiation fields will be 30%of the total time allotted for those activities (per conversation with Mac McCoy on 12-17-97).*
8. *Average radiation dose rates for TFF Closure are given in EDF-TFC-041.*
9. *The average yearly worker radiation dose is based on a 19-year time frame that begins with Site Preparation in 2004 and concludes with filling the tanks with LLW grout in 2024.*

Calculations for dosage rates are presented below.The numbers in parentheses are code designators from the Tank Farm Closure Feasibility Study cost estimates.

SITE PREPARATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	5,605	1,682	1	1,682
Utility Earthwork (1.3.2.1)	1,850	555	1	555
Special Construction(1.3.13)	1,200	360	1	360
Utilities (1.3.15.1)	950	285	1	285
VOG Installation/Removal(1.3.15.2)	5,129	1,539	1	1,539
Temporary Power Hookup(1.3.16.2)	5,108	1,532	1	1,532
DOSAGE SUBTOTAL				5,953

**Rad Exposure = Labor x 30%*

CHARACTERIZATION

ActivityDose Rate(mR/hr)Exposure Time(man-hrs)Dosage(mR)

Characterize Heel(1.3.1)10 3 rad workers x 1 hour/sample990 x 33 samples = 99 man-hrs_____

DOSAGE SUBTOTAL990

TANK ISOLATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	16,294	4,888	1	4,888
Isolate Tank Lines(1.3.2.3)	2,960	888	1	888
Tank Line Isolation(1.3.15.2)	18,972	5,692	1	5,692
Tank Line Isolation(1.3.15.2)	10,725	3,218	30	96,525
VOG System(1.3.15.3)	4,840	1,452	5	7,260
Tank Elec./Inst. Isolation(1.3.16.1)	264	79	1	79
DOSAGE SUBTOTAL				115,332

**Rad Exposure = Labor x 30%*

WASH INTERIOR TANK WALLS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*24,846*	*7,454*	*1*	*7,454*
Access Tank Risers(1.3.2.1)	*1,760*	*528*	*5*	*2,640*
Heel Mixing & Removal(1.3.4.2)	*1,760*	*528*	*1*	*528*
Heel Mixing & Removal(1.3.4.2)	*5,280*	*1,584*	*5*	*7,920*
Shielding(1.3.6)	*1,760*	*528*	*5*	*2,640*
Tank Internal Washdown(1.3.7)	*16,500*	*4,950*	*5*	*24,750*
Tank Internal Washdown(1.3.7)	*5,280*	*1,584*	*1*	*1,584*
Equipment Removal(1.3.11.1)				
Remove Jets, Corrosion Coupons	*7,040*	*2,112*	*5*	*10,560*
Set Up/Remove Rad Tent	*7,040*	*2,112*	*1*	*2,112*
Cut & Box Removed Equipment	*3,520*	*1,056*	*5*	*5,280*
Heel Transfer Lines(1.3.15.1)				
Valve Box Tie-In	*880*	*264*	*30*	*7,920*
Rad Tent, Transfer Line	*5,885*	*1,766*	*1*	*1,766*
Temporary Power(1.3.16.1)	*7,920*	*2,376*	*1*	*2,376*
Camera & Lighting(1.3.16.2)	*1,760*	*528*	*5*	*2,640*
Rad Monitoring System(1.3.16.3)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*80,829*

**Rad Exposure = Labor x 30%*

SOLIDIFY REMAINING HEEL

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions(1.3.1)	*2,874*	*862*	*1*	*862*
Heel Solidification(1.3.3.3)				
Mounting Frames, Grouting	*3,150*	*945*	*1*	*945*
Install/Remove Temp. Shielding	*1,760*	*528*	*5*	*2,640*
Grout Delivery Piping(1.3.15.5)	*1,128*	*338*	*1*	*338*
Temporary Power(1.3.16.1)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*5,446*

**Rad Exposure = Labor x 30%*

CLFS SUBTOTAL = 5,953 + 990 + 115,332 + 80,829 + 5,446=208,550 mRem

FILL VAULT WITH CLEAN GROUT - TANK EMPTY

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*14,558*	*4,367*	*1*	*4,367*
Access Vault Top, Core Drill(1.3.2.1)	*11,456*	*3,437*	*1*	*3,437*
Tank Vault Access Holes(1.3.3.1)	*12,276*	*3,683*	*1*	*3,683*
Vault & Tank Grouting(1.3.3.2)	*15,226*	*4,568*	*1*	*4,568*
Grout Delivery Piping(1.3.15.1)	*1,079*	*324*	*1*	*324*
Tank Leak Monitor/Vent.(1.3.15.2)	*1,540*	*462*	*1*	*462*
DOSAGE SUBTOTAL				*16,841*

Rad Exposure = Labor x 30%

CLASS C GROUT IN TANK VOIDS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*20,933*	*6,280*	*1*	*6,280*
Concrete (1.3.3)				
Load Distribution	*6,000*	*1,800*	*1*	*1,800*
Grout Delivery	*22,560*	*6,768*	*5*	*33,840*
Mechanical(1.3.15)				
Pipe Installation	*8,400*	*2,520*	*1*	*2,520*
Pipe Removal, Handling, Disposal	*18,905*	*5,672*	*5*	*28,358*
Electrical (1.3.16)	*3,960*	*1,188*	*5*	*5,940*
DOSAGE SUBTOTAL				*78,737*

TOTAL DOSAGE

Major Activity	***Major Subtotal***
Site Preparation	*5,953*
Characterization	*990*
Tank Isolation	*115,332*
Wash Interior Tank Walls	*80,829*
Stabilize Remaining Heel	*5,446*
Fill Vault With Clean Grout, Tank Empty	*16,841*
Class C Grout in Tank Voids	*78,737*
TOTAL DOSAGE	**304,128 mRem**

Total calculated dosage = 304,128 mRem = 304.1 Rem

D&D period = 19 years.

Average number of workers per year = 11.6

Therefore,

Average annual worker radiation dose (Rem/yr) = 304.1/19/11.6 =1.38 Rem/yr

Heavy Equipment	
Equipment used	Cement trucks, backhoes, cranes, front-end loaders, graders

These are the principal pieces of heavy equipment that will be used.

Trips	2,192

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours spent by the cement trucks on the road between the Central Facility Area (CFA) and ICPP is calculated below.

It is assumed that the grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.

STABILIZE REMAINING HEEL

Cement Truck Travel Usage

73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour/truck = ...80 hrs

FILL VAULT WITH CLEAN GROUT

Cement Truck Travel Usage

[21,080 yd^3 + 44 yd^3("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]

x 1 truck/10 yd^3 x 1 hour/truck = ...2,112hrs

TOTAL HOURS = 80 + 2,112 = 2,192 hrs

TOTAL TRIPS = 2,192 hrsx1 round trip/hour =2,192 round trips between CFA and ICPP (round trips are approximately 10 miles, i.e., 5 miles in each direction).

Hours of Operation	22,300

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours that heavy equipment operates is shown below.

HEAVY EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,080 = 9,166 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 = 7,282 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

TOTAL HOURS OPERATION = 9,166 + 7,282 + 5,852 =22,300 hours

Acres Disturbed	
New	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous	2.6 acres in the Tank Farm Facility

Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'.Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'.

Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2x 1 acre/43,560 ft^2 = 2.56 acres

Revegetated	None

Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.

Air Emissions	
Type:	Radionuclides
Quantity (Curies/year)	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)

This information comes from EDF-TFC-043.The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year.Refer to the EDF for a complete listing and release rates of the individual radionuclides.

Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year)	850

The main source of emissions will be from heavy equipment fuel combustion.

Retrieve this info from Rod Kimmitt..........30,434 liters/year

Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500

Adding water to heel remaining in the waste storage tanks and pumping it out produces the first waste stream.The next stream is from flushing decontamination solution through the waste transfer piping and then flushing the tank cooling coil lines three times with water.

Activity	*Waste Type*	*Volume (gal)*	*# Tanks*	*Total Waste (gal)*	*Total Waste (liters)*
Adjust Heel pH	*Mixed*	*52,800*	*11*	*580,800*	*2,198,560*
Decon Transfer Piping	*Mixed*	*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines	*Hazardous*	*21,000*	*8*	*21,000*	*79,493*
MIXED WASTE VOLUME =				*745,800*	*2,823,151*
HAZARDOUS WASTE VOLUME =		*21,000*		*21,000*	*79,493*
TOTAL EFFLUENT WASTE VOLUME =				*766,800*	*2,902,645*

Solid Wastes	
Type:	Industrial
Quantity (m^3):	115

The wastes listed below are from the sprung structure, the footings required to position it, and items from the temporary Ventilation Off Gas system used during closure.

Item	*Dimensions*	*Quantity*	*Total Waste(yd³)*	*Total Waste(m³)*
Sprung Structure	*55,000 ft²*			
BLDG Supports	*6"X6" X 400'*	25	92.6	70.8
BLDG Supports	*6'X6"X 100'*	20	18.5	14.2
Footings	*250 'X 2 ' X 1 '*	2	37.0	28.3
VOG Sled			1.0	0.8
VOG Duct	*4" X 400 '*		1.3	1.0
Total Solid Waste Vol.=			150.4	115.0

Radioactive Wastes

Type:	Mixed
Quantity (m³):	2,060
Activity (Ci):	570

During closure the tanks will be isolated requiring a temporary line being installed to an adjacent valve box, for pumping the adjusted heel out of the tank being closed to the heel receiver tank. Class C grout will require piping be set in place and remain until the tanks are filled.

The following assumptions were made when determining radioactive waste quantities:

8. ***The radioactive waste of concern is waste that is generated during D&D that will require treatment outside of the facility such as PPE or HEPA filters.***
9. ***Equipment such as the submersible pumps and mixing pumps and piping that is contaminated during D&D activities will be left behind in the tanks.***
10. ***Contaminated temporary transfer lines will also be left behind in the tanks.***
11. ***Per Mac McCoy, 1-27-98, a HEPA filter with 500 mRem will have a count of 0.3 curies and a bag full of PPE (5 anti-Cs per bag) will have a count of 0.001 curies.***

Item	*Dimensions*	*Quantity*	*Total Waste(yd³)*	*Total Waste(m³)*
HEPA Filters	*2' x 2' x 1'*	44	6.5	5.0
Personal Protective Equipment	*1' x 1' x 1'*	72,000	2,666.7	2,038.7
Class C Grout delivery piping	*4"X6000'*		19.4	14.8
Total Radioactive Waste Volume			2,692.6	2,058.5

PPE Quantity= 10 workers x 2/day x 225 days/yr x 16 yrs = 72,000 PPEs

HEPA Filter = 0.3 Ci/filter (assuming 500 mRem at contact) =0.3 x 44= 13.2 Ci

PPE Ci = 0.001 Ci/bag (2 mR/bag) = 0.001 x 72,000/5 = 14.4 Ci

Volumes of LLW grout that will be produced from the various categories of waste was obtained from the "TRU Separations Options Scoping Study Report", INEEL/EXT-97-01428, December 1997.These volumes are shown in the table below.Also shown in the table are expected curie activities for the Sodium-Bearing, Alumina, and Zirconia LLW grout.These values were obtained from EDF-TFC-039 (Table 3) and represent the combined activities of Cs-137 and Sr-90.These two radionuclides are the largest contributors to curie activity.

Type Waste	Volume (m3)	Vol. %	Ci/m3	Vol % * Ci/m^3
Sodium Bearing	2,992	0.132	107	14.1
Alumina	7,240	0.319	1300	415.2
Zirconia	12,439	0.549	900	493.8
Total Ci/m^3 =				923.1

Fractional amounts of the waste were calculated to determine the average Ci/m^3 that may be expected from the LLW grout.The average value calculated was 923.1 Ci/m^3.

This option uses 6,000 ft of piping that will be set and remain in place until the tanks are filled with Class C grout.The following are calculations used to determine the Curies that will remain in the piping at completion of grouting.Assumed a 4-inch diameter piping and a residue of 1 mm will remain on the inside of the piping.

Piping Circumference = π d = π (4/12) =1.05ft6,000 ft of pipe 1mm of residue=0.0033 ft.

Volume of residue = 1.05 ft x 6,000 ft x .0033 ft =20.7 ft^3=0.585 m^3

Total Curies = m^3 x Ci/m^3 0.585 m^3 x 923.1 Ci/m^3 = 540.3 Ci

Hazardous/Toxic Chemicals

Type:	Nitric Acid
Storage/Inventory:	18,900
Type:	Aluminum Nitrate
Storage/Inventory:	18,900

The following chemicals may possibly be used for the decontamination activities

Item	Chemicals	Molarity	Inventory
Decontamination Solution	Al. Nitrate	0.5 molar	5,000 (gal)
Decontamination Solution	Nitric Acid	6 molar	5,000 (gal)
Cooling Water Additive	Potassium Dichromate		21,000 (gal)

Pits/Ponds Created (m^2):	37

Cement Truck wash down pit20'X 20'=400 ft^{2}400 ft^2= 37.2 m^2

Water Usage (liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)

The water used is for rinsing the solids from the sides of the tanks, flushing the waste transfer piping three times.Flushing the cooling water lines three times (7000 gals each time).Grout truck clean up after delivering load.Flushing the grout piping with water between pigs using compressed air, and adding water to tanks for pH adjustment.(from Table 8-2 Tank Farm Closure Study)

SUPPORTING DATA & CALCULATIONS – OPTION 4

Activity	*Trucks*	*Water/ Tank (gal)*	*# Tanks*	*Total (gal)*	*Total (liters)*
Wash Tank Interior		*15,000*	*11*	*165,000*	*624,591*
Decon Transfer Piping		*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines		*21,000*	*8*	*21,000*	*79,493*
Grout truck cleaning	*2,192*	*5*	*11*	*10,960*	*41,488*
Clean Grouting Equip.		*2*	*11*	*22*	*17*
Water Spray (Dust Control)		*3000*	*11*	*33,000*	*25,229*
Heel pH Adjustment		*39,000*	*11*	*429,000*	*327,971*
TOTAL WATER VOLUME =				*823,982*	*1,723,379*

Energy Requirements	
Electrical (MWh/yr)	1,150

The following assumptions were made when determining the electrical energy requirements:

23. *A "Sprung Structures" will be installed that requires lighting, heating, and ventilation.*
24. *The area that the Sprung Structure covers will be approximately 55,000 ft^2. The average height of the structure is estimated to be approximately 40', the cubic footage would be about 2,200,000 ft^3.*
25. *There will be 1 air change per hour in the Sprung Structure. The ventilation blower would have to move approximately 36,700 cfm of air.*
26. *The ventilation system will require three 7.5 HP blower motors that operate continuously. By comparison, the Type 2 storage buildings at RWMC have 7.5 HP blower motors that move about 14,000 cfm for an air change of one/hr.*
27. *The average lighting in the Sprung Structure will be 1.75 watts/ft^2 (per EDF-VWO-005, Electrical Requirements for the Vitrification Facility). The lights will be on 24 hrs/day.*
28. *The tank mixer will require a 60 HP motor based on the mixer motor used in the Kaiser Study, Conceptual Design Report, Tank Farm Heel Removal Project, RPT-034).*
29. *The mixer will operate for 7 days per tank.*
30. *Steam heat exchangers will be used for heating the Sprung Structure (i.e., electrical power will not be used for heating).*
31. *Evaporative cooling will be used to cool the Sprung Structure (i.e., air-conditioning equipment with compressors will not be used).*
32. *The motors will operate at 75% efficiency. Therefore, 1 HP will require 1 kW of electrical power.*
33. *A 10% contingency will be added to account for incidental loading such as construction trailer lighting and ventilation, hand tools, submersible pump, etc.*

ELECTRICAL LOADS

Load Type	KW(=HP)	# of motors	total ft^2	watts/ft^2	days/year	hrs/yr*	KW-Hrs/yr	MW-Hrs/yr
Lighting(Sprung)			55,000	1.75	365	8,760	843,150	843.2
Mixer Motor	60	1				97	5,836	5.8
Blower Motors	7.5	3			365	8,760	197,100	197.1
SUBTOTAL								**1,046.1**
10% Contingency								104.6
TOTAL ELECTRICAL DEMAND								**1,150.7**

**For the mixer motors, hrs/yr. =1 mixer/tank x 11 tanks x 7 days/mixer x 24 hrs/day ÷ 19 years*

Fossil fuel (liters)	578,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, etc.) cranes, cement trucks, work trucks, grout pumps, etc..Listed below are assumptions used to derive the fuel consumption amounts.

1. *The number of hours that fossil fuel burning equipment will be used for activities such as site preparation was estimated by dividing the number of labor hours by 25%, i.e.,*

   Equipment Usage (hrs) = Activity Labor Hours x 25%

2. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment".Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates.Average fuel consumption rates are shown below.Photocopies of applicable pages from the reference guide are included as an attachment.*

   Crane Support = 4.65 gal/hr

   Average for Earth-Moving Equipment = 3.69 gal/hr

   Backhoe = 2.45 gal/hr

   Front-end loader = 4.03 gal/hr

   Grader = 4.31 gal/hr

   Average fuel consumption = (2.45 + 4.03 + 4.31)/3 = 3.69 gal/hr

   Cement Truck = 9.80 gal/hr

   Grout Pump = 7.14 gal/hr

3. *The grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.*
4. *A Ready-Mix cement truck holds approximately 10 yds^3.*
5. *73 yds^3 of grout/cement will be required to fill the tank to a 12" depth.*
6. *D&D activities begin with Site Preparation in 2004 and conclude with LLW grout filling in 2024 (19 years).*

Equipment usage hours for the tasks are shown below.

SITE PREPARATION

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)800 800 x 100% = 800
Crane Support

Utility Earthwork(1.3.2.1)1,8501,850 x 25% = 463

Special Construction(1.3.13) 1,2001,200 x 25% = 300

1,563hrs

TANK ISOLATION

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)2,3262,326 x 100% = 2,326
Crane Support

Isolate Tank Lines(1.3.2.3)2,9602,960 x 25%=740

3,066hrs

WASH INTERIOR TANK WALLS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,5503,550 x 100% = 3,550
Crane Support

Access Tank Risers(1.3.2.1) 1,7601,760 x 25% = 440

SOLIDIFY REMAINING HEEL

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 410410 x 100% = 410
Crane Support

Heel Solidification(1.3.3.3)
Place Wet Grout400400 x 25% = 100
Place Dry Grout110110 x 25% = 28

Cement Truck Travel Usage
73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour/truck = ...80 hrs

Grout Pump Usage – assume same time as it takes to place wet grout 100 hrs

718 Hrs

FILL VAULTWITH CLEAN GROUT – TANK EMPTY

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,080 2,080 x 100% = 2,080
Crane Support

Access Vault Top for Core Drills(1.3.2.1)11,456 11,456 x 25% = 2,864

Tank Vault Access Holes(1.3.3.1)9,9009,900 x 25% = 2,475

Vault and Tank Grouting(1.3.3.2)
Grout Placement, Cleanup 13,070 13,070 x 25% = 3,268
Grout Over Tank Monitor Feet1,056 1,056 x 25% = 264

Cement Truck Travel Usage
[21,080 yd^3 + 44 yd^3("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd^3 x 1 hour/truck = ...2,112hrs

Grout Pump Usage – assume same time as it takes to place wet grout (3,268 + 264)3,532hrs

16,595 hrs

CLASS C GROUT IN TANK VOIDS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,990 2,990 x 100% = 2,990
Crane Support

EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,080+ 2,990 = 12,156 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 = 7,282 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

Grout Pump = 100 + 3,268 + 264 = 3,632 hrs

Equipment	*Equip. Usage (hrs)*	*Fuel Use Rate (gal/hr)*	*Fuel Usage (gal)*	*Fuel Usage (liters)*
Crane Support	*12,156*	*4.65*	*56,525*	*213,949*
Earth-Moving	*7,282*	*3.69*	*26,871*	*101,705*
Cement Truck	*5,852*	*9.80*	*57,350*	*217,068*
Grout Pump	*3,632*	*7.14*	*25,932*	*98,154*
TOTAL FUEL USAGE			*166,678*	*630,876*

FUEL USAGE/YEAR = 630,876 liters/19 years = 33,204 liters/year

Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Nuclear Regulatory Commission (NRC) Licensing as Near-Surface Disposal Area RCRA Subtitle D Landfill Requirements applicable to NRCClass C Disposal Site (40 CFR 257) Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm-water Pollution Prevention Plan (SWPPP)

The information for the permits necessary for Option 4 was taken from Section 4, Table 4.1 of the 90% Draft Report. Table 4.1 was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill.

Remaining Radioactive Material	
Quantity (m^3):	15,600 (LLW grout deposited in tank voids)
Curies:	14,500,000

Remaining radioactive waste after the Tank Farm Facility has been closed will come from several sources:

3. *Residual waste left behind after the tanks have been washed*
4. *LLW grout that has been deposited in the tank voids*

Curies for the remaining tank waste is determined first. Total curies for the LLW grout will then determined. As a last step, the curies from the two waste forms will be added together. The contribution to the overall curie count from the remaining tank waste should be negligible compared to the LLW grout contribution.

Radioactive Tank Waste, Total Curies

The curie total is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts. After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any radioactive waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Rick Gavalya calculated the curie contribution from the liquid portion of the 12" heel. Table 16 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the curie content of the 12" heel. Table 16 shows the activities in milliCuries/liter for the radioactive components of the heel. The total mCi/liter for each tank was added up and is presented in the table below.

Tank #	mCi/liter	Heel Volume (gal)	Heel Volume (liters)	Curies/Tank
WM-180	55.99	14,688	55,594	3,113
WM-181	67.97	14,688	55,594	3,779
WM-182	1,382.44	14,688	55,594	76,855
WM-183	477.54	14,688	55,594	26,548
WM-184	52.67	14,688	55,594	2,928
WM-185	247.02	14,688	55,594	13,733
WM-186	78.56	14,688	55,594	4,367
WM-187	496.07	14,688	55,594	27,579
WM-188	670.02	14,688	55,594	37,249
WM-189	233.82	14,688	55,594	12,999
WM-190	16.54	14,688	55,594	920
TOTAL COMBINED CURIES FOR ALL TANKS =				210,070

Adding the curie contribution for each tank yields a total curie count = 210,070. This is representative of what the curie total would be for the liquid portion of the heels at the beginning of D&D.

Mac McCoy researched the heel solids to estimate the curie content. 10 of the 11 tanks have approximately 1" of solids while the remaining tank has about 4" of solids. The total curie amount contributed by the solids was estimated to be 245,000 curies. Refer to the attached write-up for calculations.

Adding the two totals together yields 455,070 curies (210,070 + 245,000). This is the assumed curie total at the beginning of D&D activities.

Initial Total Curies in Tanks at beginning of D&D = 455,070 Ci

Since the tanks will be closed to landfill standards, the degree of tank cleaning will be less than that of risk-based clean closure. If we assume that 75% of the liquid waste and solids is removed from the tank by a "1-pass" cleaning effort (and subsequently processed/calcined), 25% of the waste will remain in the tanks.

Remaining Tank Waste Activity=455,070 Cix 25%=113,767 Ci

Calculate Remaining Waste Volume and Expected Curies

The residual waste left behind for RBCC should be negligible in comparison to the waste resulting from the LLW grout that is deposited in the tank voids. Therefore, only the waste from the LLW grout will be considered when estimating the quantity and curies remaining after the Tank Farm Facility is closed.

Cesium-137 and Strontium-90 will contribute the most to curie count in the LLW grout. Per EDF-TFC-039, the following curie concentrations are given for Alumina calcine, Zirconia calcine, and sodium-bearing waste:

Sodium-Bearing Waste

Sr-90 = 52 ci/m³
Cs-137 = 55 ci/m³

Alumina Calcine

Sr-90 = 620 ci/m³
Cs-137 = 680 ci/m³

Zirconia Calcine

Sr-90 = 510 ci/m³
Cs-137 = 390 ci/m³

The "TRU Separations Options Scoping Study Report" (INEEL/EXT-97-01428) estimates the volumes of LLW grout resulting from sodium-bearing waste, Alumina calcine, and Zirconia calcine. The volumes for each category are:

Sodium-Bearing Waste = 2,992 m³

Alumina Calcine = 7,240 m³

Zirconia Calcine = 12,439 m³

Adding the 3 waste categories together yields a volume = 22,671 m³

To find out the average curie count for the waste, fractions of the waste total are multiplied by their respective curie concentration, that is,

Curie/m³ = (2,992/22,671) x (52+55) + (7,240/22,671) x (620 + 680) + (12,439/22,671) x (510 + 390) = 923 Curies/m³

Per EDF-TFC-029, the combined volume of the 11 tanks = 20,436 yd³= 15,625 m³

Assuming that the tanks are filled completely with LLW grout,

15,625 m³ x 923 Curies/m³ =14,421,447 Curies of waste remaining in the TFF

Combined Activities from LLW Grout and Remaining Tank Wastes

The total activity expected in the TFF resulting from the LLW grout deposited in the tanks and the waste remainingin the tanks after a 1-pass cleaning is:

Total Curies = 14,421,447+113,767=14,535,214 Curies of waste remaining in the TFF.

Remaining Hazardous Material (kg):	600

The hazardous waste amount is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any hazardous waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Table 12 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the hazardous waste content of the 12" heel.Table 12 shows the molarity of six RCRA wastes in the 11 tanks.The waste molarities were averaged and then converted to g/liter.The total mass of each RCRA waste was then calculated.The results are presented in the table below.

RCRA Waste	Ave. Molarity (moles/liter)	Mole Wt. (g/mole)	Conc. (g/liter)	Heel Volume 11 tanks (gal)	Heel Vol. (liters)	Total Mass (kg)	25% Mass (kg)
Cadmium	0.0031	112.4	0.3484	161,568	611,535	213	53.3
Chromium	0.0051	52.0	0.2652	161,568	611,535	162	40.5
Fluoride	0.1250	19.0	2.3750	161,568	611,535	1,452	363.1
Lead	0.0010	207.2	0.2072	161,568	611,535	127	31.7
Mercury	0.0029	200.6	0.5817	161,568	611,535	356	88.9
Nickel	0.0022	58.7	0.1291	161,568	611,535	79	19.7
25% OF RCRA WASTE TOTAL MASS =							597.3

If we assume that 75% of the liquid waste is removed from the tank through a 1-pass cleaning efforts (and subsequently processed/calcined), 25% of the hazardous waste will remain in the tanks.

2,389 kgx 25%= 597.3 kg of RCRA wastes left behind

Estimate of Diesel Engine Emissions					
Tank Farm Closure					
- Option 4 -					
Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O2, 79% N2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: C9H18 + 13.5O2 —>9CO2 + 9H2O					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NOx = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				30,434	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				60,259	
Total Lbs. of Fuel Used				**60,259**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				478	
Total Lb-Moles of Fuel (as C9H18)				**478**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				1,506,483	
Total Lbs. of Air Added				**1,506,483**	
Lb-Moles of Air for Combustion Fuel				-	
Lb-Moles of Air for Operations Fuel				-	
Lb-Moles of Air for D&D Fuel				**51,948**	
Total Lb- Moles of Air				**51,948**	
Grand Total of Materials Fed, Lbs.				***1,566,742***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		

Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		187,493	94	4,261	1,529,769
H2O		76,702	38	4,261	1,529,769
O2		144,551	72	4,517	1,621,683
N2		1,149,082.90	575	41,039	14,732,884
Subtotal of Major Gases		**1,557,828**	**779**	**54,078**	**19,414,105**
SO2		1,168	0.6		
Particulates		214	0.1		
CO		3,785	1.9		
NOx (assumed NO)		3,245	1.6		
Unburned Hydrocarbons		681	0.3		
Subtotal of Contaminants		**9,093**	**5**		
Major Gases and Contaminants - Total			783	**Tons**	

Table 5. Project Data Sheet for ICPP Tank Farm Closure – Option 5 (CLFS, CERCLA Fill)

Generic Information	
Description/Function	Tank Farm Closure – Option 5 (Close to RCRA Landfill Standards, CERCLA Fill)
This is the title of the project data sheet	
EIS Alternative	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW), CERCLA Waste
Per explanation on page C-1 ("Technical Data Requirements for the INEEL High-Level Waste and Facilities Disposition EIS", Halliburton NUS Corp., Nov. 14, 1997) and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "Environmental Restoration". ***The waste stream should be mixed low-level waste after the heel has been diluted with water during pH adjustment and tank washdown. The tank voids will then be subsequently filled with CERCLA Waste.***	
Action Type	D&D on existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000 ft^2 area in the tank farm will be erected .
Relevant structures are the 11 underground storage tanks and vaults. A temporary weather enclosure such as a Sprung Structure will be installed to allow year-round closure work in the tank farm.	
Size (m^2)	10,400
Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'. Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'. ***Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2= 10,373 m^2***	
Other Features (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup.	
Location	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL

The Tank Farm Facility is located at ICPP

Candidate for Privatization?	No

The work to be performed is D&D in nature and does not involve construction and operation of a facility.

Construction Information	
Cost ($):Preconstruction	$ 46,300,000

Regulatory Compliance	$16,100,000
Design	20,700,000
Proof of Process/ORR	9,500,000
Total PreConstruction	**$46,300,000**

Preconstruction costs cited above are from the Option 5 cost estimates (Jan 23, 1998)).

Regulatory Compliance costs include: Air Permitting, Air Monitors, RCRA Closure Plan, Project Management, G&A Adders, etc.,

Also included in Regulatory Compliance costs are activities for Regulatory Affairs Oversight.Although these activities will be ongoing throughout the D&D process and probably should be placed with the D&D costs, it would be confusing to extract these costs from this section and place them on the construction side of the cost equation.The oversight costs (without adders and contingency) are about $213,000 and represent a small portion of the overall costs.

Cost ($):Construction/D&D	$ 148,600,000

Site Preparation	$11,900,000
Characterize Heel	2,300,000
Tank Isolation	10,200,000
Wash Interior Tank Walls	32,500,000
Solidify Remaining Heel	12,400,000
Fill Vault Voids with Clean Grout	22,400,000
Fill Tank Voids with CERCLA Soil	56,900,000
Total Construction/D&D	**$148,600,000**

Construction costs cited above are from the Option 5 cost estimates (Jan. 23, 1998).

Schedule Start/End:Preconstruction	
Regulatory Compliance	2000 – 2030
Design	2000 – 2005
Proof of Process/ORR	2004 – 2006

Schedule dates are from the Option 5 cost estimate (Jan. 23, 1998).

Schedule Start/End:Construction	
Site Preparation	2004 – 2013
Characterize Heel	2001 – 2017
Tank Isolation	2006 – 2013

Wash Interior Tank Walls	2006 – 2016
Stabilize Remaining Heel	2008 – 2018
Fill Vault Voids with Clean Grout	2022 – 2030
Fill Tank Voids with CERCLA Soil	2013 – 2021
Schedule dates are from the Option 5 cost estimate (Jan. 23, 1998). ***NOTE: From this point, the following data is based on the 90% Review cost estimates (where applicable).***	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 8.8
New:	0.9
Existing:	7.9
Radiation:	8.8 (includes all employees)

Several assumptions were made to arrive at the estimated number of workers required.
The assumptions are:

29. *Estimates are given for the average number of workers per year that will be required to complete TFF closure.*
30. *The average number of worker per year is based on D&D activities that begin with Site Preparation in 2004 and conclude with tank void filling in 2030 for a total of 26 years.*
31. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97). This ratio assumes a 10% worker turnover rate.*
32. *Total number of construction labor hours = Total labor hours + ((Total Subcontract Cost – G&A/PIF) *0.55)/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
33. *Subcontract labor hours = (Total Subcontract Cost – G&A/PIF)*0.55/($33/hr)*
34. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
35. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	*Hours*
Site Preparation	*22,191*
Tank Isolation	*69,871*
Wash Interior Tank Walls	*105,667*
Stabilize Remaining Heel	*12,252*
Fill Vault Voids	*61,914*
CERCLA Soil in Tank Voids	*79,663*
SUBTOTAL HOURS	*351,558*

SUBCONTRACT HOURS

Activity	*Total S/C ($)*	*G&A/PIF($)*	*S/C -G&A/PIF ($)*	*Hours**
Site Preparation	*1,222,294*	*571,794*	*650,500*	*10,842*
Characterization	*1,293,514*	*303,514*	*990,000*	*16,500*
Tank Isolation	*188,922*	*173,922*	*15,000*	*250*
Wash Interior Tank Walls	*1,672,404*	*1,452,404*	*220,000*	*3,667*
Stabilize Remaining Heel	*467,680*	*467,680*	*0*	*0*
Fill Vault Voids	*1,237,213*	*1,237,213*	*0*	*0*
CERCLA Soil in Tank Voids	*3,305,878*	*1,482,878*	*1,823,000*	*30,383*
SUBTOTAL HOURS				*61,642*

**Subcontract labor hours calculated per Assumption #5 formula.*
Total Labor Hours = 351,558 + 61,642 = 413,200 hours
D&D Time Period= 26 years (2004 – 2030)
Average Number of Employees per Year = 413,200/26/1800
= 8.8Employees/Year
#of existing workers per year=8.8 x 90% =7.9 existing workers per year
#of new workers per year=8.8 x 10%=0.9 new workers per year

Average annual worker radiation dose (rem/yr.)	1.14 Rem/yr.

The following assumptions were made when calculating the average worker radiation dose per year.

10. For activities where radiation exposure is expected, the estimated #of hours worked in radiation fields will be 30%of the total time allotted for those activities (per conversation with Mac McCoy on 12-17-97).

11. Average radiation dose rates for TFF Closure are given in EDF-TFC-041.

12. The average yearly worker radiation dose is based on a 26-year time frame that begins with Site Preparation in 2004 and concludes with CERCLA soil fill in 2030.

Calculations for dosage rates are presented below.The numbers in parentheses are code designators from the Tank Farm Closure Feasibility Study cost estimates.

SITE PREPARATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	5,605	1,682	1	1,682
Utility Earthwork (1.3.2.1)	1,850	555	1	555
Special Construction (1.3.13)	1,200	360	1	360
Utilities (1.3.15.1)	950	285	1	285
VOG Installation/Removal(1.3.15.2)	5,129	1,539	1	1,539
Temporary Power Hookup(1.3.16.2)	5,108	1,532	1	1,532
DOSAGE SUBTOTAL				5,953

**Rad Exposure = Labor x 30%*

CHARACTERIZATION

ActivityDose Rate(mR/hr)Exposure Time(man-hrs)Dosage(mR)

Characterize Heel(1.3.1)10 3 rad workers x 1 hour/sample990
x 33 samples = 99 man-hrs _____

DOSAGE SUBTOTAL990

TANK ISOLATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	16,294	4,888	1	4,888
Isolate Tank Lines(1.3.2.3)	2,960	888	1	888
Tank Line Isolation(1.3.15.2)	18,972	5,692	1	5,692
Tank Line Isolation(1.3.15.2)	10,725	3,218	30	96,525
VOG System(1.3.15.3)	4,840	1,452	5	7,260
Tank Elec./Inst. Isolation(1.3.16.1)	264	79	1	79
DOSAGE SUBTOTAL				115,332

**Rad Exposure = Labor x 30%*

WASH INTERIOR TANK WALLS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*24,846*	*7,454*	*1*	*7,454*
Access Tank Risers(1.3.2.1)	*1,760*	*528*	*5*	*2,640*
Heel Mixing & Removal(1.3.4.2)	*1,760*	*528*	*1*	*528*
Heel Mixing & Removal(1.3.4.2)	*5,280*	*1,584*	*5*	*7,920*
Shielding(1.3.6)	*1,760*	*528*	*5*	*2,640*
Tank Internal Washdown(1.3.7)	*16,500*	*4,950*	*5*	*24,750*
Tank Internal Washdown(1.3.7)	*5,280*	*1,584*	*1*	*1,584*
Equipment Removal(1.3.11.1)				
Remove Jets, Corrosion Coupons	*7,040*	*2,112*	*5*	*10,560*
Set Up/Remove Rad Tent	*7,040*	*2,112*	*1*	*2,112*
Cut & Box Removed Equipment	*3,520*	*1,056*	*5*	*5,280*
Heel Transfer Lines(1.3.15.1)				
Valve Box Tie-In	*880*	*264*	*30*	*7,920*
Rad Tent, Transfer Line	*5,885*	*1,766*	*1*	*1,766*
Temporary Power(1.3.16.1)	*7,920*	*2,376*	*1*	*2,376*
Camera & Lighting(1.3.16.2)	*1,760*	*528*	*5*	*2,640*
Rad Monitoring System(1.3.16.3)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*80,829*

**Rad Exposure = Labor x 30%*

STABILIZE REMAINING HEEL

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions(1.3.1)	*2,874*	*862*	*1*	*862*
Heel Solidification(1.3.3.3)				
Install/Remove Mounting Frames	*3,150*	*945*	*1*	*945*
Install/Remove Temp. Shielding	*1,760*	*528*	*5*	*2,640*
Grout Delivery Piping(1.3.15.5)	*1,128*	*338*	*1*	*338*
Temporary Power(1.3.16.1)	*2,200*	*660*	*1*	*660*
DOSAGE SUBTOTAL				*5,446*

**Rad Exposure = Labor x 30%*

FILL VAULT WITH CLEAN GROUT - TANK EMPTY

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*14,558*	*4,367*	*1*	*4,367*
Access Vault Top, Core Drill(1.3.2.1)	*11,456*	*3,437*	*1*	*3,437*
Tank Vault Access Holes(1.3.3.1)	*12,276*	*3,683*	*1*	*3,683*
Vault & Tank Grouting(1.3.3.2)	*15,226*	*4,568*	*1*	*4,568*
Grout Delivery Piping(1.3.15.1)	*1,079*	*324*	*1*	*324*
Tank Leak Monitor/Vent.(1.3.15.2)	*1,540*	*462*	*1*	*462*
DOSAGE SUBTOTAL				*16,841*

****Rad Exposure = Labor x 30%***

CLFS SUBTOTAL = 5,953 + 990 + 115,332 + 80,829 + 5,446 + 16,841 = 225,391 mRem

CERCLA SOIL IN TANK VOIDS

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*20,718*	*6,215*	*1*	*6,215*
Site Work (1.3.2)	*11,610*	*3,483*	*5*	*17,415*
Conveying Systems (1.3.14)	*40,166*	*12,050*	*1*	*12,050*
DOSAGE SUBTOTAL				*35,680*

TOTAL DOSAGE

Major Activity	*Major Subtotal*
Site Preparation	*5,953*
Characterization	*990*
Tank Isolation	*115,332*
Wash Interior Tank Walls	*80,829*
Stabilize Remaining Heel	*5,446*
Fill Vault With Clean Grout, Tank Empty	*16,841*
CERCLA Soil in Tank Voids	*35,680*
TOTAL DOSAGE	**261,071 mRem**

Total calculated dosage = 261,071 mRem = 261.1 Rem

Construction time period = 26 years.

Average number of workers per year = 8.8

Therefore,

Average annual worker radiation dose (Rem/yr.) = 261.1/26/8.8 = 1.14 Rem/yr.

Heavy Equipment	
Equipment used	Cement trucks, backhoes, cranes, front-end loaders, graders

These are the principal pieces of heavy equipment that will be used.

Trips	2,192

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours spent by the cement trucks on the road between the Central Facility Area (CFA) and ICPP is calculated below.

It is assumed that the grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.

STABILIZE REMAINING HEEL

Cement Truck Travel Usage

73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour/truck = ...80 hrs

FILL VAULT WITH CLEAN GROUT

Cement Truck Travel Usage

[21,080 yd^3 + 44 yd^3("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd^3 x 1 hour/truck = ...2,112hrs

TOTAL HOURS = 80 + 2,112 = 2,192 hrs

TOTAL TRIPS = 2,192 hrsx1 round trip/hour =2,192 round trips between CFA and ICPP (round trips are approximately 10 miles, i.e., 5 miles in each direction).

Hours of Operation	31,382

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours that heavy equipment operates is shown below.

HEAVY EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,080 + 5,180 = 14,346 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 +2,902 + 1,000 =11,184 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

TOTAL HOURS OPERATION = 14,346 + 11,184 + 5,852=31,382 hours

Acres Disturbed	
New	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous	2.6 acres in the Tank Farm Facility

Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'.Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'.

Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft^2x 1 acre/43,560 ft^2 = 2.56 acres

Revegetated	None

Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.

Air Emissions	
Type:	Radionuclides
Quantity (Curies/year)	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)

This information comes from EDF-TFC-043.The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year.Refer to the EDF for complete listing and release rates of the individual radionuclides.

Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year)	720

The main source of emissions will be from heavy equipment fuel combustion.

Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	79,500

Adding water to heel remaining in the waste storage tanks and pumping out produces the first waste stream.The next stream is from flushing decontamination solution through the waste transfer piping and then flushing the tank cooling coil lines three times with water.

Activity	*Waste Type*	*Volume (gal)*	*# Tanks*	*Total Waste (gal)*	*Total Waste (liters)*
Adjust Heel pH	*Mixed*	*52,800*	*11*	*580,800*	*2,198,560*
Decon Transfer Piping	*Mixed*	*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines	*Hazardous*	*21,000*	*8*	*21,000*	*79,493*
MIXED WASTE VOLUME =				*745,800*	*2,823,151*
HAZARDOUS WASTE VOLUME =		*21,000*		*21,000*	*79,493*
TOTAL EFFLUENT WASTE VOLUME =				*766,800*	*2,902,645*

Solid Wastes	
Type:	Industrial
Quantity (m^3)	115

The wastes listed below are from the sprung structure, the footings required to position it, and items from the temporary Ventilation Off Gas system used during closure.

Item	*Dimensions*	*Quantity*	*Total Waste(yd^3)*	*Total Waste(m^3)*
Sprung Structure	*55,000 ft^2*			
BLDG Supports	*6"X6" X 400'*	*25*	*92.6*	*70.8*
BLDG Supports	*6'X6"X 100'*	*20*	*18.5*	*14.2*
Footings	*250 'X 2 ' X 1 '*	*2*	*37.0*	*28.3*
VOG Sled			*1.0*	*0.8*
VOG Duct	*4" X 400 '*		*1.3*	*1.0*
Total Solid Waste Vol.=			*150.4*	*115.0*

Radioactive Waste	
Type:	Mixed
Quantity (m^3):	2,060
Activity (Ci):	570

During closure the tanks will be isolated requiring a temporary line being installed to an adjacent valve box, for pumping the adjusted heel out of the tank being closed to the heel receiver tank. CERCLA soils will require piping be set in place and remain until the tanks are filled.

The following assumptions were made when determining radioactive waste quantities:

12. ***The radioactive waste of concern is waste that is generated during D&D that will require treatment outside of the facility such as PPE or HEPA filters.***
13. ***Equipment such as the submersible pumps and mixing pumps and piping that is contaminated during D&D activities will be left behind in the tanks.***
14. ***Contaminated temporary transfer lines will also be left behind in the tanks.***
15. ***Per Mac McCoy, 1-27-98, a HEPA filter with 500 mRem will have a count of 0.3 curies and a bag full of PPE (5 anti-Cs per bag) will have a count of 0.001 curies.***

Item	*Dimensions*	*Quantity*	*Total Waste(yd^3)*	*Total Waste(m^3)*
HEPA Filters	*2' x 2' x 1'*	*44*	*6.5*	*5.0*
Personal Protective Equipment	*1' x 1' x 1'*	*72,000*	*2,666.7*	*2,038.7*
CERCLA Soil delivery piping	*4"X6000'*		*19.4*	*14.8*
Total RadioactiveWaste Vol.=			*2692.6*	*2058.5*

PPE Quantity= 10 workers x 2/day x 225 days/yr x 16 yrs = 72,000 PPEs

HEPA Filter = 0.3 Ci/filter (assuming 500 mRem at contact) =0.3 Ci/filter x 44 filter = 13.2 Ci

PPE Ci = 0.001 Ci/bag (assuming 2 mR/bag) = 0.001Ci/bag x 72,000/5 PPE/(PPE/bag) = 14.4 Ci

Because there is no data at the present time for the CERCLA soil grout activity levels, a judgement was made to substitute the LLW grout activity values for Curies calculations

Volumes of LLW grout that will be produced from the various categories of waste was obtained from the "TRU Separations Options Scoping Study Report", INEEL/EXT-97-01428, December 1997.These volumes are shown in the table below.Also shown in the table are expected curie activities for the Sodium-Bearing, Alumina, and Zirconia LLW grout.These values were obtained from EDF-TFC-039 (Table 3) and represent the combined activities of Cs-137 and Sr-90.These two radionuclides are the largest contributors to curie activity.

Type Waste	Volume (m3)	Vol. %	Ci/m3	Vol % * Ci/m^3
Sodium Bearing	2,992	0.132	107	14.1
Alumina	7,240	0.319	1300	415.2
Zirconia	12,439	0.549	900	493.8
Total Ci/m^3 =				923.1

Fractional amounts of the waste were calculated to determine the average Ci/m^3 that may be expected from the LLW grout.The average value calculated was 923.1 Ci/m^3.

This option uses 6,000 ft of piping that will be set and remain in place until the tanks are filled with CERCLA Soil Grout.The following are calculations used to determine the Curies that will remain in the piping at completion of grouting.Assumed a 4-inch diameter piping and a residue of 1 mm will remain on the inside of the piping.

Piping Circumference = $\pi d = \pi (4/12)$ =1.05ft6,000 ft of pipe 1mm of residue=0.0033 ft.

Volume of residue = 1.05 ft x 6,000 ft x .0033 ft =20.7 ft^3=0.585 m^3

Total Curies = m^3 x Ci/m^3 0.585 m^3 x 923.1 Ci/m^3 = 540.3 Ci

Hazardous/Toxic Chemicals

Item:	Nitric Acid
Inventory/ Storage (liters):	18,900
Item:	Aluminum Nitrate
Inventory/ Storage (liters):	18,900

The following chemicals may possibly be used for the decontamination activities.

Item	Chemicals	Molarity	Inventory
Decontamination Solution	AL Nitrate	0.5 molar	5,000 (gal)
Decontamination Solution	Nitric Acid	6 molar	5,000 (gal)
Cooling Water Additive	Potassium Dichromate		21,000 (gal)

Cultural Resource Effects	None

Pits/Ponds Created (m^2)	37
Cement Truck wash down pit20'X 20'=400 $ft^2$400 ft^2 = 37.2 m^2	
Water Usage(liters):	1,723,000
Source:	ICPP Deep Wells (Snake River Aquifer)

The water used is for rinsing the solids from the sides of the tanks, flushing the waste transfer piping three times. Flushing the cooling water lines three times (7000 gals each time). Grout truck clean up after delivering load. Flushing the grout piping with water between pigs using compressed air, and adding water to tanks for pH adjustment. (from Table 8-2 Tank Farm Closure Study)

Activity	***Trucks***	***Water/ Tank (gal)***	***# Tanks***	***Total (gal)***	***Total (liters)***
Wash Tank interior		***15,000***	***11***	***165,000***	***624,591***
Decon Transfer Piping		***15,000***	***11***	***165,000***	***624,591***
Flush Cooling Lines		***21,000***	***8***	***21,000***	***79,493***
Grout truck cleaning	***2,192***	***5***	***11***	***10,960***	***41,488***
Clean Grouting Equip.		***2***	***11***	***22***	***17***
Water Spray (Dust Control)		***3000***	***11***	***33,000***	***25,229***
Heel pH addjustment		***39,000***	***11***	***429,000***	***327,971***
TOTAL WATER VOLUME =				***823,982***	***1,723,379***

Energy Requirements	
Electrical (MWh/yr)	1,150

The following assumptions were made when determining the electrical energy requirements:

34. *A "Sprung Structures" will be installed that requires lighting, heating, and ventilation.*
35. *The area that the Sprung Structure covers will be approximately 55,000 ft^2. The average height of the structure is estimated to be approximately 40', the cubic footage would be about 2,200,000 ft^3.*
36. *There will be 1 air change per hour in the Sprung Structure. The ventilation blower would have to move approximately 36,700 cfm of air.*
37. *The ventilation system will require three 7.5 HP blower motors that operate continuously. By comparison, the Type 2 storage buildings at RWMC have 7.5 HP blower motors that move about 14,000 cfm for an air change of one/hr.*
38. *The average lighting in the Sprung Structure will be 1.75 watts/ft^2 (per EDF-VWO-005, Electrical Requirements for the Vitrification Facility). The lights will be on 24 hrs/day.*
39. *The tank mixer will require a 60 HP motor based on the mixer motor used in the Kaiser Study, Conceptual Design Report, Tank Farm Heel Removal Project, RPT-034).*
40. *The mixer will operate for 7 days per tank.*
41. *Steam heat exchangers will be used for heating the Sprung Structure (i.e., electrical power will not be used for heating).*
42. *Evaporative cooling will be used to cool the Sprung Structure (i.e., air-conditioning equipment with compressors will not be used).*
43. *The motors will operate at 75% efficiency. Therefore, 1 HP will require 1 kW of electrical power.*
44. *A 10% contingency will be added to account for incidental loading such as construction trailer lighting and ventilation, hand tools, submersible pump, etc.*

ELECTRICAL LOADS

Load Type	KW(=HP)	# of motors	total ft^2	watts/ft^2	days/year	hrs/yr*	KW-Hrs/yr	MW-Hrs/yr
Lighting(Sprung)			55,000	1.75	365	8,760	843,150	843.2
Mixer Motor	60	1				71	4,265	4.3
Blower Motors	7.5	3			365	8,760	197,100	197.1
SUBTOTAL								**1,044.5**
10% Contingency								104.5
TOTAL ELECTRICAL DEMAND								**1,149.0**

**For the mixer motors, hrs/yr. =1 mixer/tankx11 tanksx 7 days/mixerx 24 hrs/day ÷ 26 years*

Fossil fuel (liters)	724,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, etc.) cranes, cement trucks, work trucks, grout pumps, etc..Listed below are assumptions used to derive the fuel consumption amounts.

7. *The number of hours that fossil fuel burning equipment will be used for activities such as site preparation was estimated by dividing the number of labor hours by 25%, i.e.,*

   Equipment Usage (hrs) = Activity Labor Hours x 25%

8. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment".Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates.Average fuel consumption rates are shown below.Photocopies of applicable pages from the reference guide are included as an attachment.*

   Crane Support = 4.65 gal/hr

   Average for Earth-Moving Equipment = 3.69 gal/hr

   Backhoe = 2.45 gal/hr

   Front-end loader = 4.03 gal/hr

   Grader = 4.31 gal/hr

   Average fuel consumption = (2.45 + 4.03 + 4.31)/3 = 3.69 gal/hr

   Cement Truck = 9.80 gal/hr

   Grout Pump = 7.14 gal/hr

9. *The grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.*

10. *A Ready-Mix cement truck holds approximately 10 yds^3.*

11. *73 yds^3 of grout/cement will be required to fill the tank to a 12" depth.*

12. *D&D activities begin with Site Preparation in 2004 and conclude with CERCLA Waste filling in 2030 (26 years).*

Equipment usage hours for the tasks are shown below.

SITE PREPARATION

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)800 800 x 100% = 800
Crane Support

Utility Earthwork(1.3.2.1)1,8501,850 x 25% = 463

Special Construction(1.3.13) 1,2001,200 x 25% = 300

1,563hrs

TANK ISOLATION

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)2,3262,326 x 100% = 2,326
Crane Support

Isolate Tank Lines(1.3.2.3)2,9602,960 x 25%=740

3,066hrs

WASH INTERIOR TANK WALLS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1)3,5503,550 x 100% = 3,550
Crane Support

Access Tank Risers(1.3.2.1) 1,7601,760 x 25% = 440

3,990hrs

SOLIDIFY REMAINING HEEL

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 410410 x 100% = 410
Crane Support

Heel Solidification(1.3.3.3)
Place Wet Grout400400 x 25% = 100
Place Dry Grout110110 x 25% = 28

Cement Truck Travel Usage
73 yd³/tankx 11 tanks x1 truck/10 yd³ x 1 hour/truck = ...80 hrs

Grout Pump Usage – assume same time as it takes to place wet grout 100 hrs

718 Hrs

FILL VAULTWITH CLEAN GROUT – TANK EMPTY

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,080 2,080 x 100% = 2,080
Crane Support

Access Vault Top for Core Drills(1.3.2.1)11,456 11,456 x 25% = 2,864

Tank Vault Access Holes(1.3.3.1)9,9009,900 x 25% = 2,475

Vault and Tank Grouting(1.3.3.2)
Grout Placement, Cleanup 13,070 13,070 x 25% = 3,268
Grout Over Tank Monitor Feet1,056 1,056 x 25% = 264

Cement Truck Travel Usage
[21,080 yd³ + 44 yd³("Fill Vault With Clean Grout – Tank Empty", 1.3.3.2)]
x 1 truck/10 yd³ x 1 hour/truck = ...2,112hrs

Grout Pump Usage – assume same time as it takes to place wet grout (3,268 + 264)3,532hrs

16,595 hrs

CERCLA SOIL IN TANK VOIDS

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 5,180 5,180 x 100% = 5,180
Crane Support

Site-work(1.3.2) 11,61011,610 x 25% = 2,902
Mix and Deliver Soil to Tanks

Special Construction(1.3.13) 240,000 x .55/33 =4,0004,000 x 25% = 1,000

EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,080 + 5,180 = 14,346 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 +2,902 + 1,000 =11,184 hrs

Cement Truck = 100 + 28 + 80 + 3,268 + 264 + 2,112 = 5,852 hrs

Grout Pump = 100 + 3,268 + 264 = 3,632 hrs

Equipment	*Equip. Usage (hrs)*	*Fuel Use Rate (gal/hr)*	*Fuel Usage (gal)*	*Fuel Usage (liters)*
Crane Support	*14,346*	*4.65*	*66,709*	*252,493*
Earth-Moving	*11,184*	*3.69*	*41,269*	*156,203*
Cement Truck	*5,852*	*9.80*	*57,350*	*217,068*
Grout Pump	*3,632*	*7.14*	*25,932*	*98,154*
TOTAL FUEL USAGE			*191,260*	*723,919*

FUEL USAGE TOTAL = 723,919 liters

FUEL USAGE/YEAR = 723,919 liters/26 years = 27,843 liters/year

Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm water Pollution Prevention Plan (SWPPP) The CERCLA Program will meet "applicable or relevant and appropriate requirements" (ARARs)
Remaining Radioactive Material:	Current tank data for radioactive material is not available at this time. Waste transfers between tanks are taking place that will affect the concentrations of radioactive material in the tanks.
Remaining Hazardous Material:	Current tank data for hazardous material is not available at this time. Waste transfers between tanks are currently taking place that will affect the concentrations of hazardous material in the tanks.

The information for the permits necessary for Option 3 was taken from Section 4, Table 4.1 of the 90% Draft Report. Table 4.1 was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill. Since CERCLA Waste will be deposited in the tank voids, the CERCLA program will be required to meet ARARs.

Remaining Radioactive Material	
Quantity (m^3):	15,600 (CERCLA Waste deposited in tank voids)
Curies:	160,000

Remaining radioactive waste after the Tank Farm Facility has been closed will come from several sources:

5. ***Residual waste left behind after the tanks have been washed***
6. ***CERCLA waste that has been deposited in the tank voids***

Curies for the remaining tank waste is determined first. Total curies for the CERCLA Waste will then determined. As a last step, the curies from the two waste forms will be added together.

Radioactive Tank Waste, Total Curies

The curie total is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts. After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any radioactive waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Rick Gavalya calculated the curie contribution from the liquid portion of the 12" heel. Table 16 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the curie content of the 12" heel. Table 16 shows the activities in milliCuries/liter for the radioactive components of the heel. The total mCi/liter for each tank was added up and is presented in the table below.

Tank #	*mCi/liter*	*Heel Volume (gal)*	*Heel Volume (liters)*	*Curies/Tank*
WM-180	*55.99*	*14,688*	*55,594*	*3,113*
WM-181	*67.97*	*14,688*	*55,594*	*3,779*
WM-182	*1,382.44*	*14,688*	*55,594*	*76,855*
WM-183	*477.54*	*14,688*	*55,594*	*26,548*
WM-184	*52.67*	*14,688*	*55,594*	*2,928*
WM-185	*247.02*	*14,688*	*55,594*	*13,733*
WM-186	*78.56*	*14,688*	*55,594*	*4,367*
WM-187	*496.07*	*14,688*	*55,594*	*27,579*
WM-188	*670.02*	*14,688*	*55,594*	*37,249*
WM-189	*233.82*	*14,688*	*55,594*	*12,999*
WM-190	*16.54*	*14,688*	*55,594*	*920*
TOTAL COMBINED CURIES FOR ALL TANKS =				*210,070*

Adding the curie contribution for each tank yields a total curie count = 210,070. This is representative of what the curie total would be for the liquid portion of the heels at the beginning of D&D.

Mac McCoy researched the heel solids to estimate the curie content. 10 of the 11 tanks have approximately 1" of solids while the remaining tank has about 4" of solids. The total curie amount contributed by the solids was estimated to be 245,000 curies. Refer to the attached write-up for calculations.

Adding the two totals together yields 455,070 curies (210,070 + 245,000). This is the assumed curie total at the beginning of D&D activities.

Initial Total Curies in Tanks at beginning of D&D = 455,070 Ci

Since the tanks will be closed to landfill standards, the degree of tank cleaning will be less than that of risk-based clean closure. If we assume that 75% of the liquid waste and solids is removed from the tank by a "1-pass" cleaning effort (and subsequently processed/calcined), 25% of the waste will remain in the tanks.

Remaining Tank Waste Activity=455,070 Cix 25%=113,767 Ci

CERCLA Waste will be placed in the tank voids for this option.The assumption is made that the CERCLA Waste that is deposited in the tanks will come from the soils in the TFF and that this will be the sole source of waste.

Asked Rene Rodriguez if there was information about the # of curies in the TFF soils.Rene referred me to a document titled "Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL – Part A, RI/BRA Report (Final)", DOE/ID-10534, November 1997.Table 5-42 on page F5-55 and F5-56 summarizes the known releases of radionuclides in the Tank Farm area.The table also shows the curies for each radionuclide.

Adding up the curies for each radionuclide yields a combined total=46,180 Ci

Table 5-42 is included as an attachment.

Combined Activities from LLW Grout and Remaining Tank Wastes

The total activity expected in the TFF resulting from the LLW grout deposited in the tanks and the waste remainingin the tanks after a 1-pass cleaning is:

Total Curies =46,180+113,767=159,947 Curies of waste remaining in the TFF.

Remaining Hazardous Material (kg):	600

The hazardous waste amount is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any hazardous waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Table 12 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the hazardous waste content of the 12" heel.Table 12 shows the molarity of six RCRA wastes in the 11 tanks.The waste molarities were averaged and then converted to g/liter.The total mass of each RCRA waste was then calculated.The results are presented in the table below.

RCRA Waste	Ave. Molarity (moles/liter)	Mole Wt. (g/mole)	Conc. (g/liter)	Heel Volume 11 tanks (gal)	Heel Vol. (liters)	Total Mass (kg)	25% Mass (kg)
Cadmium	0.0031	112.4	0.3484	161,568	611,535	213	53.3
Chromium	0.0051	52.0	0.2652	161,568	611,535	162	40.5
Fluoride	0.1250	19.0	2.3750	161,568	611,535	1,452	363.1
Lead	0.0010	207.2	0.2072	161,568	611,535	127	31.7
Mercury	0.0029	200.6	0.5817	161,568	611,535	356	88.9
Nickel	0.0022	58.7	0.1291	161,568	611,535	79	19.7
25% OF RCRA WASTE TOTAL MASS =							597.3

If we assume that 75% of the liquid waste is removed from the tank through a 1-pass cleaning efforts (and subsequently processed/calcined), 25% of the hazardous waste will remain in the tanks.

2,389 kgx 25%= 597.3 kg of RCRA wastes left behind

Estimate of Diesel Engine Emissions
Tank Farm Closure
- Option 5 -

Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O2, 79% N2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: C9H18 + 13.5O2 ---->9CO2 + 9H2O					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NOx = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				27,843	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				55,129	
Total Lbs. of Fuel Used				**55,129**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				438	
Total Lb-Moles of Fuel (as C9H18)				**438**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				1,378,229	
Total Lbs. of Air Added				**1,378,229**	
Lb-Moles of Air for Combustion Fuel				**-**	
Lb-Moles of Air for Operations Fuel				**-**	
Lb-Moles of Air for D&D Fuel				**47,525**	
Total Lb- Moles of Air				**47,525**	
Grand Total of Materials Fed, Lbs.				***1,433,358***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		

CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		-	-		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		171,530	86	3,898	1,399,532
H2O		70,172	35	3,898	1,399,532
O2		132,245	66	4,133	1,483,621
N2		1,051,255.67	526	37,545	13,478,599
Subtotal of Major Gases		**1,425,202**	**713**	**49,474**	**17,761,284**
SO2		1,068	0.5		
Particulates		196	0.1		
CO		3,463	1.7		
NOx (assumed NO)		2,968	1.5		
Unburned Hydrocarbons		623	0.3		
Subtotal of Contaminants		**8,319**	**4**		
Major Gases and Contaminants - Total			**717**	**Tons**	

Table 6. Project Data Sheet for ICPP Tank Farm Closure – Option 6 (CLFS, Clean Fill)

Generic Information	
Description/Function:	Tank Farm Closure – Option 6 (Close to RCRA Landfill Standards, Clean Fill)
This is the title of the project data sheet	
EIS Alternative:	Facility Disposition
Perdiscussion with Brent Helm on 11-19-97	
Project Type: Waste Stream:	Waste Management Program - Tank Farm Facility Closure Mixed Low-Level Waste (MLLW)
Per explanation on page C-1 ("Technical Data Requirements for the INEEL High-Level Waste and Facilities Disposition EIS", Halliburton NUS Corp., Nov. 14, 1997) and conversation with Dennis Harrell on 11-20-97, at this stage it is a "Waste Management Program" since there's still waste in the tanks. When it's turned over to CERCLA, it will be an "Environmental Restoration". ***The waste stream should be mixed low-level waste after the heel has been diluted with water during pH adjustment and tank washdown.***	
Action Type:	D&D on existing facility
The tank farm will be decommissioned and decontaminated during the closure process. The action types are shown on page C-1.	
Structure Type:	Eleven underground storage tanks (300,000 gallon capacity per tank) and associated vaults A temporary weather enclosure that encloses a 55,000-ft ^{2} area in the tank farm will be erected.
Relevant structures are the 11 underground storage tanks and vaults. A temporary weather enclosure such as a Sprung Structure will be installed to allow year-round closure work in the tank farm.	
Size (m^2)	10,400
Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'. Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'. ***Therefore, the tank farm area = 542' x 230' – (65' x 200') = 111,660 ft² = 10,373 m²***	
Other Features (pits, ponds, power/water/sewer lines)	Electrical, steam, water, firewater, and sewer will be required for the weather enclosure, heating/ventilation, and process equipment used in the closure activities.
Utilities such as electrical, steam, firewater, water, and sewer will be used for heating, lighting, D&D of the tanks and vaults, and general cleanup.	

SUPPORTING DATA & CALCULATIONS – OPTION 6

Location:	Inside the Idaho Chemical Processing Plant (ICPP) fenced boundary at the INEEL
The Tank Farm Facility is located at ICPP	
Candidate for Privatization?:	No
The work to be performed is D&D in nature and does not involve construction and operation of a facility.	
Construction Information	
Cost ($):Preconstruction	$25,400,000

Regulatory Compliance	$3,700,000
Design	14,800,000
Proof of Process/ORR	6,900,000
Total PreConstruction	**$25,400,000**

Preconstruction costs cited above are from the Option 4 cost estimates (Jan 23, 1998).

Regulatory Compliance costs include: Air Permitting, Air Monitors, RCRA Closure Plan, Project Management, G&A Adders, etc.,

Also included in Regulatory Compliance costs are activities for Regulatory Affairs Oversite.Although these activities will be ongoing throughout the D&D process and probably should be placed with the D&D costs, it would be confusing to extract these costs from this section and place them on the construction side of the cost equation.The oversite costs (without adders and contingency) are about $145,000 and represent a small portion of the overall costs.

Cost ($):Construction/D&D	$ 96,300,000

Site Preparation	***$12,200,000***
Characterize Heel	***2,300,000***
Tank Isolation	***10,200,000***
Wash Interior Tank Walls	***31,000,000***
Solidify Remaining Heel	***12,400,000***
Fill Vault and Tank with Clean Grout	***28,200,000***
Total Construction/D&D	***$96,300,000***

Construction costs cited above are from the Option 6 cost estimates (Jan. 23, 1998).

Schedule Start/End:Preconstruction	
Regulatory Compliance	2002 – 2021
Design:	2000 – 2005
Proof of Process/ORR:	2004 – 2006
Schedule dates are from the Option 6 cost estimate (Jan 23, 1998).	
Schedule Start/End:Construction	

Site Preparation	2004 – 2013
Characterize Heel	2001 – 2017
Tank Isolation	2006 – 2013
Wash Interior Tank Walls	2006 – 2016
Solidify Remaining Heel	2008 – 2018
Fill Vault and Tank with Clean Grout	2013 – 2021
Schedule dates are from the Option 6 cost estimate (Jan. 23, 1998).	
No. of workers each year of construction or D&D: (new/existing/radiation)	Average # of workers/year = 10.6
New:	1.1
Existing:	9.5
Radiation:	10.6 (includes all employees)

Several assumptions were made to determine the estimated number of workers required.

The assumptions are:

36. *Estimates are given for the average number of workers per year required to complete TFF closure.*
37. *The average number of workers per year is based on D&D activities that begin with Site Preparation in 2004 and conclude with tank and vault grouting in 2020 for a total of 16 years.*
38. *The labor force will be comprised of 90% "existing" workers and 10% "new" workers (per conversation with Bryan Spaulding on 12-2-97).This ratio assumes a 10% worker turnover rate.*
39. *Subcontract labor hours = (Total Subcontract Cost – G&A/PIF) *0.55/($33/hr)*
40. *Total number of construction labor hours = Total labor hours + (Total Subcontract Cost – G&A, PIF) *0.55/($33/hr) where $33/hr represents the average labor cost (per Rick Adams on 12-1-97).*
41. *All workers will be considered radiation workers since Radiation Worker training will be required for all personnel entering the TFF.*
42. *The average employee works 1800 hours per year (per conversation with Rick Adams on 12-2-97).*

Calculations are shown below.

LABOR HOURS

Activity	Hours
Site Preparation	23,391
Tank Isolation	69,871
Wash Interior Tank Walls	105,667
Stabilize Remaining Heel	12,252
Fill Vault/Tank Voids w/Clean Grout	63,231
SUBTOTAL HOURS	274,412

SUBCONTRACT HOURS

Activity	Total S/C($)	G&A,PIF($)	S/C-G&A,PIF($)	Hours*
Site Preparation	1,131,405	480,905	650,500	10,842
Characterization	1,293,514	303,514	990,000	16,500
Tank Isolation	188,922	173,922	15,000	250
Wash Interior Tank Walls	1,672,404	1,452,404	220,000	3,667
Solidify Remaining Heel	467,680	467,680	0	0
Fill Vault/Tank Void w/Clean Grout	1,714,112	1,714,112	0	0
SUBTOTAL HOURS				31,258

**Subcontract labor hours calculated per Assumption #5 formula.*

Total Labor Hours = 274,412 + 31,258 = 305,670 hours

D&D Time Period= 16 years (2004 – 2020)

Average Number of Employees per Year = 305,670/16/1800

= 10.6Employees/Year

#of existing workers per year=10.6 x 90% =9.5 existing workers per year

#of new workers per year=10.6 x 10%= 1.1 new workers per year

Average annual worker radiation dose (Rem/yr):	33 Re

The following assumptions were made when estimating the average worker radiation dose per year.

13. *For activities where radiation exposure is expected, the estimated # of hours worked in radiation fields will be 30% of the total time estimated for those activities (per conversation with Mac McCoy on 12-17-97). Mac McCoy reviewed the activities in the cost estimates and assigned exposure rates for those activities where radiation fields could be encountered.*
14. *Average radiation dose rates for TFF Closure are given in EDF-TFC-041.*
15. *The average yearly worker radiation dose is based on a 16-year time frame that begins with Site Preparation in 2004 and concludes with tank and vault grouting in 2020.*

Calculations for dosage rates are presented below. The numbers in parentheses are code designators from the Tank Farm Closure Feasibility Study cost estimates dated October 23, 1997.

In the cost estimate, activities where workers could be exposed to radiation fields are highlighted with a yellow marker.

SITE PREPARATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	5,605	1,682	1	1,682
Utility Earthwork (1.3.2.1)	1,850	555	1	555
Special Construction(1.3.13)	1,200	360	1	360
Utilities (1.3.15.1)	950	285	1	285
VOG Installation/Removal(1.3.15.2)	5,129	1,539	1	1,539
Temporary Power Hookup(1.3.16.2)	5,108	1,532	1	1,532
DOSAGE SUBTOTAL				5,953

*Rad Exposure = Labor x 30%

CHARACTERIZATION

ActivityDose Rate(mR/hr)Exposure Time(man-hrs)Dosage(mR)

Characterize Heel(1.3.1)10 3 rad workers x 1 hour/sample990

x 33 samples = 99 man-hrs _____

DOSAGE SUBTOTAL990

TANK ISOLATION

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	16,294	4,888	1	4,888
Isolate Tank Lines(1.3.2.3)	2,960	888	1	888
Tank Line Isolation(1.3.15.2)	18,972	5,692	1	5,692
Tank Line Isolation(1.3.15.2)	10,725	3,218	30	96,525
VOG System(1.3.15.3)	4,840	1,452	5	7,260
Tank Elec./Inst. Isolation(1.3.16.1)	264	79	1	79
DOSAGE SUBTOTAL				115,332

*Rad Exposure = Labor x 30%

WASH INTERIOR TANK WALLS

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions (1.3.1)	24,846	7,454	1	7,454
Access Tank Risers(1.3.2.1)	1,760	528	5	2,640
Heel Mixing & Removal(1.3.4.2)	1,760	528	1	528
Heel Mixing & Removal(1.3.4.2)	5,280	1,584	5	7,920
Shielding(1.3.6)	1,760	528	5	2,640
Tank Internal Washdown(1.3.7)	16,500	4,950	5	24,750
Tank Internal Washdown(1.3.7)	5,280	1,584	1	1,584
Equipment Removal(1.3.11.1)				
Remove Jets, Corrosion Coupons	7,040	2,112	5	10,560
Set Up/Remove Rad Tent	7,040	2,112	1	2,112
Cut & Box Removed Equipment	3,520	1,056	5	5,280
Heel Transfer Lines(1.3.15.1)				
Valve Box Tie-In	880	264	30	7,920
Rad Tent, Transfer Line	5,885	1,766	1	1,766
Temporary Power(1.3.16.1)	7,920	2,376	1	2,376
Camera & Lighting(1.3.16.2)	1,760	528	5	2,640
Rad Monitoring System(1.3.16.3)	2,200	660	1	660
DOSAGE SUBTOTAL				80,829

**Rad Exposure = Labor x 30%*

SOLIDIFY REMAINING HEEL

Activity	Labor (hrs)	Rad Exposure* (hrs)	Dose Rate (mR/hr)	Dosage (mR)
General Conditions(1.3.1)	2,874	862	1	862
Heel Solidification(1.3.3.3)				
Install/Remove Mounting Frames	3,150	945	1	945
Install/Remove Temp. Shielding	1,760	528	5	2,640
Grout Delivery Piping(1.3.15.5)	1,128	338	1	338
Temporary Power(1.3.16.1)	2,200	660	1	660
DOSAGE SUBTOTAL				5,446

**Rad Exposure = Labor x 30%*

CLFS SUBTOTAL = 5,953 + 990 + 115,332 + 80,829 + 5,446 = 208,550 mRem

FILL VAULT AND TANK VOIDS WITH CLEAN GROUT

Activity	*Labor (hrs)*	*Rad Exposure* (hrs)*	*Dose Rate (mR/hr)*	*Dosage (mR)*
General Conditions (1.3.1)	*14,871*	*4,461*	*1*	*4,461*
Access Vault Top, Core Drill(1.3.2.1)	*11,456*	*3,437*	*1*	*3,437*
Tank Vault Access Holes(1.3.3.1)	*12,276*	*3,683*	*1*	*3,683*
Vault & Tank Grouting(1.3.3.2)	*16,109*	*4,833*	*1*	*4,833*
Grout Delivery Piping(1.3.15.1)	*1,079*	*324*	*1*	*324*
Tank Leak Monitor/Vent.(1.3.15.2)	*1,540*	*462*	*1*	*462*
DOSAGE SUBTOTAL				*17,199*

Rad Exposure = Labor x 30%

TOTAL DOSAGE

Major Activity	*Major Subtotal*	
Site Preparation	*5,953*	
Characterization	*990*	
Tank Isolation	*115,332*	
Wash Interior Tank Walls	*80,829*	
Stabilize Remaining Heel	*5,446*	
Fill Vault/Tank Voids c̲ Clean Grout	*17,199*	
TOTAL DOSAGE	**225,749**	**mRem**

Total calculated dosage = 225,749 mRem = 225.7 Rem

Construction time period = 16 years.

Average number of workers per year = 10.6

Therefore,

Average annual worker radiation dose (Rem/yr) = 225.7/16/10.6 = 1.33 Rem/yr

Heavy Equipment	
Equipment used	Cement trucks, backhoes, cranes, front-end loaders, graders

These are the principal pieces of heavy equipment that will be used.

Trips	3,993 round trips (100 miles per round trip)

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours spent by the cement trucks on the road between the Central Facility Area (CFA) and ICPP is calculated below.

It is assumed that the grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.

STABILIZE REMAINING HEEL

Cement Truck Travel Usage

73 yd³/tankx 11 tanks x1 truck/10 yd³ x 1 hour/truck = ...80 hrs

FILL VAULT & TANK VOIDS WITH CLEAN GROUT

Cement Truck Travel Usage

[39,080 yd³ + 44 yd³("Fill Vault and Tank Voids With Clean Grout", 1.3.3.2)]
x 1 truck/10 yd³ x 1 hour/truck = ...3,912hrs

TOTAL HOURS = 80 + 3,912 = 3,992 hrs

TOTAL TRIPS = 3,992 hrsx1 round trip/hour =3,992 round trips between CFA and ICPP (round trips are approximately 10 miles, i.e., 5 miles in each direction).

Hours of Operation	24,300

From the "Energy Requirements – Fossil Fuel" section of this Project Data Sheet (see below), the hours that heavy equipment operates is shown below.

<u>HEAVY EQUIPMENT USAGE SUBTOTALS</u>

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,125 = 9,211 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 = 7,282 hrs

Cement Truck = 100 + 28 + 80 + 3,420 + 264 + 3,912 = 7,804 hrs

TOTAL HOURS OPERATION = 9,211 + 7,282 + 7,804 =24,297 hours

Acres Disturbed	
New	None

No new area will be disturbed in the Tank Farm Facility, the area was previously disturbed during construction activities and is no longer in the natural state (i.e., sagebrush, rolling hills, ravines, etc.)

Previous	2.6 acres in the Tank Farm Facility

Per Dwg. 137918 (from Documetrix), the overall dimensions of the tank farm are 542 ± 5' by 230 ±5'.Included in these dimensions is a section in the southeast corner that measures roughly 65' by 200'.

Therefore, the tank farm area = 542' x 230' – (65' x 200')= 111,660 ft² x 1 acre/43,560 ft² = 2.56 acres

Revegetated	None
Revegetation will not take place during this option. Another program such as CERCLA may come in at a later date and revegetate the area to natural conditions.	
Air Emissions	
Type:	Radionuclides
Quantity (Curies/year):	0.031 (the individual release rates for 24 radionuclides were calculated and then added together to obtain a total release rate of 0.031 curies/year)
This information comes from EDF-TFC-043.The release rate is calculated by adding the individual release rates of 24 radionuclides (americium thru zirconium) to obtain a total release rate of 0.031 curies/year.Refer to the EDF for a complete listing and release rates of the individual radionuclides.	
Type:	Chemical – fuel combustion emissions including the following constituents: CO, CO_2, H_2O, N_2, NO, O_2, SO_2, particulates and unburned hydrocarbons
Quantity (tons/year):	1,050
Retrieve this info from Rod Kimmitt's program	
Effluents	
Type:	Mixed
Quantity (liters):	2,800,000
Type:	Hazardous
Quantity (liters):	80,000

Adding water to heel remaining in the waste storage tanks and pump out produces the first waste stream.The next stream is from flushing decontamination solution through the waste transfer piping and then flushing the tank cooling coil lines three times with water.

Activity	*Waste Type*	*Volume (gal)*	*# Tanks*	*Total Waste (gal)*	*Total Waste (liters)*
Adjust Heel pH	*Mixed*	*52,800*	*11*	*580,800*	*2,198,560*
Decon Transfer Piping	*Mixed*	*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines	*Hazardous*	*21,000*	*8*	*21,000*	*79,493*
MIXED WASTE VOLUME =				*745,800*	*2,823,151*
HAZARDOUS WASTE VOLUME =		*21,000*		*21,000*	*79,493*
TOTAL EFFLUENT WASTE VOLUME =				*766,800*	*2,902,645*

Solid Wastes	
Type:	Industrial
Quantity (m^3)	115

The wastes listed below are from the sprung structure, the footings required to position the structure, and items from the temporary Ventilation Off Gas system used during closure.

Item	Dimensions	Quantity	Total Waste(yd^3)	Total Waste(m^3)
Sprung Structure	55,000 ft^2			
BLDG Supports	6"X6" X 400'	25	92.6	70.8
BLDG Supports	6'X6"X 100'	20	18.5	14.2
Footings	250 'X 2 ' X 1 '	2	37.0	28.3
VOG Sled			1.0	0.8
VOG Duct	4" X 400 '		1.3	1.0
Total Solid Waste Vol.=			150.4	115.0

Radioactive Wastes	
Type:	Mixed
Quantity (m^3):	2,040
Activity (Ci):	30

The following assumptions were made when determining radioactive waste quantities:

16. ***The radioactive waste of concern is waste that is generated during D&D that will require treatment outside of the facility such as PPE or HEPA filters.***
17. ***Equipment such as the submersible pumps and mixing pumps and piping that is contaminated during D&D activities will be left behind in the tanks.***
18. ***Contaminated temporary transfer lines will also be left behind in the tanks.***
19. ***Per Mac McCoy, 1-27-98, a HEPA filter with 500 mRem will have a count of 0.3 curies and a bag full of PPE (5 anti-Cs per bag) will have a count of 0.001 curies.***

Item	Dimensions	Quantity	Total Waste(yd^3)	Total Waste(m^3)
HEPA Filters	2' x 2' x 1'	44	6.5	5.0
Personal Protective Equipment	1' x 1' x 1'	72,000	2,666.7	2,038.7
Total Radioactive Waste Volume			2,673.2	2,043.7

PPE Quantity= 10 workers x 2/day x 225 days/yr x 16 yrs = 72,000 PPEs

HEPA Filter = 0.3 Ci/filter (assuming 500 mRem at contact) =0.3 x 44= 13.2 Ci

PPE Ci = 0.001 Ci/bag (2 mR/bag) = 0.001 x 72,000/5 = 14.4 Ci

Hazardous/Toxic Chemicals	
Item:	Nitric Acid
Inventory/ Storage (liters):	18,900
Item:	Aluminum Nitrate

Inventory/ Storage (liters):	18,900

The following chemicals may possibly be used for the decontamination activities

Item	*Chemicals*	*Molarity*	*Inventory*
Decontamination Solution	*AL Nitrate*	*0.5 molar*	*5,000 (gal)*
Decontamination Solution	*Nitric Acid*	*6 molar*	*5,000 (gal)*
Cooling Water Additive	*Potassium Dichromate*		*21,000 (gal)*

Pits/Ponds Created (m^2)	37

Cement Truck wash down pit20'X 20'=400 ft^2 400 ft^2= 37.2 m^2

Water Usage(liters):	1,760,000
Source:	ICPP Deep Wells (Snake River Aquifer)

The water used is for rinsing the solids from the sides of the tanks, flushing the waste transfer piping three times. Flushing the cooling water lines three times (7000 gals each time). Grout truck clean up after delivering load. Flushing the grout piping with water between pigs using compressed air, and adding water to tanks for pH adjustment. (From Table 8-2 ICCP Tank Farm Closure Study 90% Draft INEEL/EXT-97-10204, January 98.)

Activity	*Trucks*	*Water/ Tank (gal)*	*# Tanks*	*Total (gal)*	*Total (liters)*
Wash Tank Interior		*15,000*	*11*	*165,000*	*624,591*
Decon Transfer Piping		*15,000*	*11*	*165,000*	*624,591*
Flush Cooling Lines		*21,000*	*8*	*21,000*	*79,493*
Grout truck cleaning	*4,000*	*5*	*11*	*20,000*	*75,708*
Clean Grouting Equip.		*2*	*11*	*22*	*17*
Water Spray (Dust Control)		*3000*	*11*	*33,000*	*25,229*
Heel pH Adjustment		*39,000*	*11*	*429,000*	*327,971*
TOTAL WATER VOLUME =				*833,022*	*1,757,599*

Energy Requirements	
Electrical (MW-hr/yr.)	1,150

The following assumptions were made when determining the electrical energy requirements:

45. *A "Sprung Structures" will be installed that requires lighting, heating, and ventilation.*
46. *The area that the Sprung Structure covers will be approximately 55,000 ft^2. The average height of the structure is estimated to be approximately 40', the cubic footage would be about 2,200,000 ft^3.*
47. *There will be 1 air change per hour in the Sprung Structure. The ventilation blower would have to move approximately 36,700 cfm of air.*
48. *The ventilation system will require three 7.5 HP blower motors that operate continuously. By comparison, the Type 2 storage buildings at RWMC have 7.5 HP blower motors that move about 14,000 cfm for an air change of one/hr.*
49. *The average lighting in the Sprung Structure will be 1.75 watts/ft^2 (per EDF-VWO-005, Electrical Requirements for the Vitrification Facility). The lights will be on 24 hrs/day.*
50. *The tank mixer will require a 60 HP motor based on the mixer motor used in the Kaiser Study, Conceptual Design Report, Tank Farm Heel Removal Project, RPT-034).*
51. *The mixer will operate for 7 days per tank.*
52. *Steam heat exchangers will be used for heating the Sprung Structure (i.e., electrical power will not be used for heating).*
53. *Evaporative cooling will be used to cool the Sprung Structure (i.e., air-conditioning equipment with compressors will not be used).*
54. *The motors will operate at 75% efficiency. Therefore, 1 HP will require 1 kW of electrical power.*
55. *A 10% contingency will be added to account for incidental loading such as construction trailer lighting and ventilation, hand tools, submersible pump, etc.*

ELECTRICAL LOADS

Load Type	KW(=HP)	# of motors	total ft^2	watts/ft^2	days/year	hrs/yr*	KW-Hrs/yr	MW-Hrs/yr
Lighting(Sprung)			55,000	1.75	365	8,760	843,150	843.2
Mixer Motor	60	1				116	6,930	6.9
Blower Motors	7.5	3			365	8,760	197,100	197.1
SUBTOTAL								**1,047.2**
10% Contingency								104.7
TOTAL ELECTRICAL DEMAND								**1,151.9**

**For the mixer motors, hrs/yr. =1 mixer/tankx11 tanksx 7 days/mixerx 24 hrs/day ÷ 16 years*

Fossil fuel (liters):	656,000

Fossil fuel will be consumed by earth-moving equipment (backhoes, front-end loaders, graders, etc.) cranes, cement trucks, work trucks, grout pumps, etc..Listed below are assumptions used to derive the fuel consumption amounts.

13. *The number of hours that fossil fuel burning equipment will be used for activities such as site preparation was estimated by dividing the number of labor hours by 25%, i.e.,*

    Equipment Usage (hrs) = Activity Labor Hours x 25%

14. *Hourly fuel consumption rates are based on information obtained from the 1988 version of "Cost Reference Guide for Construction Equipment".Although the reference guide is outdated, it is assumed that the 1988 fuel consumption rates for heavy equipment are similar to 1997 fuel consumption rates.Average fuel consumption rates are shown below.Photocopies of applicable pages from the reference guide are included as an attachment.*

    Crane Support = <u>4.65 gal/hr</u>

    Average for Earth-Moving Equipment = <u>3.69 gal/hr</u>

    Backhoe = 2.45 gal/hr

    Front-end loader = 4.03 gal/hr

    Grader = 4.31 gal/hr

    Average fuel consumption = (2.45 + 4.03 + 4.31)/3 = 3.69 gal/hr

    Cement Truck = <u>9.80 gal/hr</u>

    Grout Pump = <u>7.14 gal/hr</u>

15. *The grout/cement will be produced in a batch plant located at the Central Facility Area (CFA), the round trip will be approximately 10 miles.The combined time to load the truck at the CFA batch plant and the "road time" for travel to/from CFA to CPP is estimated to be approximately 1 hour.*
16. *A Ready-Mix cement truck holds approximately 10 yds^3.*
17. *73 yds^3 of grout/cement will be required to fill the tank to a 12" depth.*
18. *Construction begins in 2004 and finishes in 2020 (16 years).*

Equipment usage hours for the tasks are shown below.

SITE PREPARATION

<u>Activity</u> <u>Total Labor (hrs)Equipment Usage (hrs)</u>

General Conditions(1.3.1)800 800 x 100% = 800
Crane Support

Utility Earthwork(1.3.2.1)1,8501,850 x 25% = 463

Special Construction(1.3.13) 1,2001<u>,200 x 25% = 300</u>

1,563hrs

TANK ISOLATION

<u>Activity</u> <u>Total Labor (hrs)Equipment Usage (hrs)</u>

General Conditions(1.3.1)2,3262,326 x 100% = 2,326
Crane Support

Isolate Tank Lines(1.3.2.3)2,960<u>2,960 x 25%=740</u>

3,066hrs

WASH INTERIOR TANK WALLS

<u>Activity</u> <u>Total Labor (hrs)Equipment Usage (hrs)</u>

General Conditions(1.3.1)3,5503,550 x 100% = 3,550
Crane Support

Access Tank Risers(1.3.2.1) 1,760<u>1,760 x 25% =440</u>

SOLIDIFY REMAINING HEEL

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 410410 x 100% = 410
Crane Support

Heel Solidification(1.3.3.3)
Place Wet Grout400400 x 25% = 100
Place Dry Grout110110 x 25% = 28

Cement Truck Travel Usage
73 yd^3/tankx 11 tanks x1 truck/10 yd^3 x 1 hour/truck = ...80 hrs

Grout Pump Usage – assume same time as it takes to place wet grout 100 hrs

718 Hrs

FILL VAULT & TANK VOIDS WITH CLEAN GROUT

Activity Total Labor (hrs)Equipment Usage (hrs)

General Conditions(1.3.1) 2,125 2,125 x 100% = 2,125
Crane Support

Access Vault Top for Core Drills(1.3.2.1)11,456 11,456 x 25% = 2,864

Tank Vault Access Holes(1.3.3.1)9,9009,900 x 25% = 2,475

Vault and Tank Grouting(1.3.3.2)
Grout Placement, Cleanup 13,678 13,678 x 25% = 3,420
Grout Over Tank Monitor Feet1,056 1,056 x 25% = 264

Cement Truck Travel Usage
[39,080 yd^3 + 44 yd^3("Fill Vault and Tank Voids With Clean Grout", 1.3.3.2)]
x 1 truck/10 yd^3 x 1 hour/truck = ...3,912hrs

Grout Pump Usage – assume same time as it takes to place wet grout (3,420 + 264)3,684hrs

18,744 hrs

EQUIPMENT USAGE SUBTOTALS

Crane Support = 800 + 2,326 + 3,550 + 410 + 2,125 = 9,211 hrs

Earth-Moving Equipment = 463 + 300 + 740 + 440 + 2,864 + 2,475 = 7,282 hrs

Cement Truck = 100 + 28 + 80 + 3,420 + 264 + 3,912 = 7,804 hrs

Grout Pump = 100 + 3,420 + 264 = 3,784 hrs

Equipment	*Equip. Usage (hrs)*	*Fuel Use Rate (gal/hr)*	*Fuel Usage (gal)*	*Fuel Usage (liters)*
Crane Support	*9,211*	*4.65*	*42,831*	*162,116*
Earth-Moving	*7,282*	*3.69*	*26,871*	*101,705*
Cement Truck	*7,804*	*9.80*	*76,479*	*289,474*
Grout Pump	*3,784*	*7.14*	*27,018*	*102,262*
TOTAL FUEL USAGE			*173,199*	*655,557*

FUEL USAGE/YEAR = 655,557 liters/16 years = 40,972 liters/year

Permits needed:	Atomic Energy Act (AEA), Energy Reorganization Act Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPs) Hazardous Waste Management Act (HWMA), Resource Conservation and Recovery Act (RCRA) Closure Executive Order 11988 (Floodplain Management) INEEL Site Treatment Plan (STP) Federal Facility Agreement/Consent Order [FFA/CO (CERCLA)] 3/30/92 Consent Order (with 3/17/94 modification) Storm water Pollution Prevention Plan (SWPPP)

The information for the permits necessary for Option 6 was taken from Section 4, Table 4.1 of the 90% Draft Report. Table 4.1 was constructed to list permits that would be necessary if the tank voids were used as a LLW Landfill.

Remaining Radioactive Material	
Quantity (m^3):	600
Curies:	114,000

Remaining radioactive waste after the Tank Farm Facility has been closed will come from residual waste left behind after the tanks have been washed

Radioactive Tank Waste, Total Curies

The curie total is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any radioactive waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Rick Gavalya calculated the curie contribution from the liquid portion of the 12" heel.Table 16 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the curie content of the 12" heel.Table 16 shows the activities in milliCuriesi/liter for the radioactive components of the heel.The total mCi/liter for each tank was added up and is presented in the table below.

Tank #	mCi/liter	Heel Volume (gal)	Heel Volume (liters)	Curies/Tank
WM-180	55.99	14,688	55,594	3,113
WM-181	67.97	14,688	55,594	3,779
WM-182	1,382.44	14,688	55,594	76,855
WM-183	477.54	14,688	55,594	26,548
WM-184	52.67	14,688	55,594	2,928
WM-185	247.02	14,688	55,594	13,733
WM-186	78.56	14,688	55,594	4,367
WM-187	496.07	14,688	55,594	27,579
WM-188	670.02	14,688	55,594	37,249
WM-189	233.82	14,688	55,594	12,999
WM-190	16.54	14,688	55,594	920
TOTAL COMBINED CURIES FOR ALL TANKS =				210,070

Adding the curie contribution for each tank yields a total curie count = 210,070.This is representative of what the curie total would be for the liquid portion of the heels at the beginning of D&D.

Mac McCoy researched the heel solids to estimate the curie content.10 of the 11 tanks have approximately 1" of solids while the remaining tank has about 4" of solids.The total curie amount contributed by the solids was estimated to be 245,000 curies.Refer to the attached writeup for calculations.

Adding the two totals together yields 455,070 curies (210,070 + 245,000).This is the assumed curie total at the beginning of D&D activities.

Initial Total Curies in Tanks at beginning of D&D = 455,070 Ci

Since the tanks will be closed to landfill standards, the degree of tank cleaning will be less than that of risk-based clean closure.If we assume that 75% of the liquid waste and solids is removed from the tank by a "1-pass" cleaning effort (and subsequently processed/calcined), 25% of the waste will remain in the tanks.

Remaining Tank Waste Activity=455,070 Cix 25%=113,767 Ci

Volume = 12" grouted heel in bottom of each tank.

Vol = 73 yd^3 grouted heel/tankx11 tanksx0.765 m^3/yd^3=614 m^3

Remaining Hazardous Material (kg):	600

The hazardous waste amount is based on the premise that a 12" heel is left behind in each tank at the time of turnover for D&D efforts.After cleaning efforts have taken place, remaining waste in the tanks is assumed to be the origin of any hazardous waste that is subsequently generated during removal of the tanks, piping, vaults, etc..

Table 12 in a report by Russ Garcia ("Waste Inventories/Characterization Study", INEL/EXT-97-00600, September 1997) was used to determine the hazardous waste content of the 12" heel.Table 12 shows the molarity of six RCRA wastes in the 11 tanks.The waste molarities were averaged and then converted to g/liter.The total mass of each RCRA waste was then calculated.The results are presented in the table below.

RCRA Waste	Ave. Molarity (moles/liter)	Mole Wt. (g/mole)	Conc. (g/liter)	Heel Volume 11 tanks (gal)	Heel Vol. (liters)	Total Mass (kg)	25% Mass (kg)
Cadmium	0.0031	112.4	0.3484	161,568	611,535	213	53.3
Chromium	0.0051	52.0	0.2652	161,568	611,535	162	40.5
Fluoride	0.1250	19.0	2.3750	161,568	611,535	1,452	363.1
Lead	0.0010	207.2	0.2072	161,568	611,535	127	31.7
Mercury	0.0029	200.6	0.5817	161,568	611,535	356	88.9
Nickel	0.0022	58.7	0.1291	161,568	611,535	79	19.7
25% OF RCRA WASTE TOTAL MASS =							597.3

If we assume that 75% of the liquid waste is removed from the tank through a 1-pass cleaning efforts (and subsequently processed/calcined), 25% of the hazardous waste will remain in the tanks.

2,389 kgx 25%= 597.3 kg of RCRA wastes left behind

Estimate of Diesel Engine Emissions
Tank Farm Closure
- Option 6 -

Bases & Assumptions:					
1. Air to fuel ratio = 25:1 (Mass Basis)				from Wark, K. and C.F. Warner, Air Pollution, Its Origin and Control, IEP, New York, 1976, p. 446, 423	
2. Diesel fuel density = 7.5 lbs./gal.					
3. Air is 21% O2, 79% N2, with a pseudomolecular weight of 29.					
4. Combustion is simulated as: C9H18 + 13.5O2 --->9CO2 + 9H2O					
5. Particulates = 5 mg/scf				Wark and Warner, p. 446	
6. CO = 2,500 ppmv				Wark and Warner, p. 446	
7. NOx = 2,000 ppmv				Wark and Warner, p. 446	
8. Unburned hydrocarbons = 100 ppmv				Wark and Warner, p. 446	
9. Diesel fuel (# 2 fuel oil) contains 1 wt. % sulfur				Wark and Warner, p. 336	
10. Combustion is about 99% efficient.					
Liters/yr of D&D fuel				40,972	
Lbs. Of Construction Fuel				-	
Lbs. Of Operations Fuel				-	
Lbs. Of D&D Fuel				81,125	
Total Lbs. of Fuel Used				**81,125**	
Lb-Moles of Construction Fuel				-	
Lb-Moles of Operations Fuel				-	
Lb-Moles of D&D Fuel				644	
Total Lb-Moles of Fuel (as C9H18)				**644**	
Lbs of Air for Construction Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for Operations Fuel (based on air-to-fuel ratio)				-	
Lbs.of Air for D&D Fuel (based on air-to-fuel ratio)				2,028,114	
Total Lbs. of Air Added				**2,028,114**	
Lb-Moles of Air for Combustion Fuel				-	
Lb-Moles of Air for Operations Fuel				-	
Lb-Moles of Air for D&D Fuel				**69,935**	
Total Lb- Moles of Air				**69,935**	
Grand Total of Materials Fed, Lbs.				***2,109,239***	
Exhaust Gases, Construction Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO_2		-	-	-	-
H_2O		-	-	-	-
O_2		-	-	-	-
N_2		-	-	-	-
Subtotal of Major Gases		-	-	-	-
SO_2		-	-		
Particulates		-	-		
CO		-	-		

NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		**-**	**-**		
Exhaust Gases, Operations Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		-	-	-	-
H2O		-	-	-	-
O2		-	-	-	-
N2		-	-	-	-
Subtotal of Major Gases		**-**	**-**	**-**	**-**
SO2		-	-		
Particulates		-	-		
CO		-	-		
NOx (assumed NO)		-	-		
Unburned Hydrocarbons		-	-		
Subtotal of Contaminants		**-**	**-**		
Exhaust Gases, D&D Fuel		Total Lbs.	Total Tons	Total Moles	Total SCF
CO2		252,413	126	5,737	2,059,463
H2O		103,260	52	5,737	2,059,463
O2		194,603	97	6,081	2,183,203
N2		1,546,961.44	773	55,249	19,834,256
Subtotal of Major Gases		**2,097,238**	**1,049**	**72,803**	**26,136,384**
SO2		1,572	0.8		
Particulates		288	0.1		
CO		5,096	2.5		
NOx (assumed NO)		4,368	2.2		
Unburned Hydrocarbons		917	0.5		
Subtotal of Contaminants		**12,241**	**6**		
Major Gases and Contaminants - Total			**1,055**	**Tons**	

Technical Data Requirements
for the
INEEL High-Level Waste and Facilities Disposition EIS

November 14, 1997

Prepared By
Halliburton NUS Corporation
900 Trail Ridge Road
Aiken, South Carolina

Appendix B - Blank Project Data Sheet

General Information

Description/Function:
EIS Alternative:
Project Type/Waste Stream
Action Type:
Structure Type:
    Size (m^2)
    Other Features:
    (pits, ponds, power/water/sewer lines)
Location:
    Inside/outside of fence
    Inside/outside of building
Candidate for privatization?:

Construction or D&D Information

Cost ($): Preconstruction
Cost ($): Construction
Schedule start/end: Preconstruction
Schedule start/end: Construction
No. of workers each year of construction or D&D: (new/existing)
    Number of radiation workers
Average annual worker radiation dose (rem/yr)
Heavy equipment:
    Equipment used
    Trips
    Hours of operation
Acres disturbed and duration of disturbance:
    New
    Previous
    Revegetated
Air emissions:
    Type (radioactive/chemical)
    Quantity (Ci/year / tons/year)
Effluents:
    Type
    Quantity (liters)
Solid wastes:
    Type
    Quantity (m^3)
Radioactive Waste
    Type
    Quantity (m^3 and Ci)
Hazardous/toxic chemicals and wastes
    Storage/inventory
Pits/ponds created: (m^2)
Water Usage: (liters)
    Source

Energy requirements:
- Electrical (MWH/year)
- Fossil fuel (liters)

Permits needed:
For facility closures, physical characteristics and quantities of radioactive and hazardous materials remaining after closure

---

Operational Information

Cost ($/year): operations
Schedule start/end:
No. of workers each year of operation: (new/existing)
- No. of radiation workers:

Average annual worker radiation dose (rem/yr)
Heavy equipment:
- Equipment used
- Trips
- Hours of operation

Air emissions:
- Type (radioactive/chemical)
- Quantity (Ci/year / tons/year)

Effluents:
- Type (radioactive/chemical)
- Quantity (Ci/year / tons/year)

Solid wastes:
- Type:
- Quantity (m^3/year)

Radioactive Waste
- Type
- Quantity (m^3 and Ci)

Hazardous/toxic chemicals and wastes
- Storage/inventory

Pits/ponds used: (m^2)
Water usage: (liters/year)
- Source

Energy requirements:
- Electrical: (MWH/year)
- Fossil fuel: (liters/year)

Permits needed:

Appendix C - Guidance on Completing Project Data Sheets

Parameter name	Explanation
	GENERIC INFORMATION
Description/Function	Project title
EIS alternative	Indicate which EIS alternative/option would include the project: No-Action Alternative Separations Alternative: Full Separations Option, Ten-Year Plan Option, Transuranic Separations / Class A Grout Option, Transuranic Separations / Class C Grout Option Nonseparations Alternative: Vitrified Waste Option, Hot Isostatic Pressed (HIP) Waste Option, Cementitious Waste Option, Direct Cementitious Waste Option
Project type/waste stream	Indicates the type of project: waste management program (identify waste streams), environmental restoration, or infrastructure. Acronyms used are as follows: HLW high-level waste TRU transuranic waste LLW low-level waste MLLW mixed low-level waste GTCC greater-than-Class-C waste HW hazardous waste ER environmental restoration Infra. infrastructure HAW high activity waste LAW low activity waste SBW sodium bearing waste FC facility closure
Action type	Provides the major objective of the project: New - construction of a new facility D&D - D&D on an existing facility Expand - expand a facility or process Modify - modify a facility or process Operation - operation of an existing capability
Structure type	Indicates the type of structure to be considered by the project. For D&D projects, lists the facilities that would be affected, provides the structure size (square meters), and identifies significant features.
Location	Identifies the physical location of the project in reference to existing INEEL facilities. Off-site facilities should be specifically identified if possible
Candidate for privatization	Indicates if project is a candidate for privatization

Parameter name	Explanation
CONSTRUCTION OR D&D INFORMATION	
Preconstruction (Pre-D&D) costs	Indicates project costs prior to construction or D&D
Construction (D&D) costs	Indicates project costs associated with construction or D&D
Schedule start/end: preconstruction	Provides schedule start and end dates for preconstruction activities in calendar year format (for example, 2001 - 2003)
Schedule start/end: construction	Provides schedule start and end dates for construction activities in calendar year format (for example, 2003 - 2006)
Number of workers (new/existing)	Provides the projected number of workers that would be required for each year of construction or D&D; indicates the number of these workers that would be new workers; indicates the number of radiation workers
Average annual radiation worker radiation dose	Provides the expected average annual radiation dose (rem/year) for workers involved in the project construction or D&D
Heavy equipment	Defines equipment that would be used during construction or D&D and estimates heavy equipment traffic volumes (trips) to and from the construction or D&D site and their hours of operation
Acres disturbed	Provides description of land use by identifying new or previously disturbed and revegetated areas (acres) and the duration of the disturbance
Air emissions	Identifies the type and lists quantities (Ci/year or tons/year) of air emissions that would be generated during construction or D&D
Effluents	Identifies the type and lists amounts (liters) or liquid wastes that would be generated during construction or D&D
Solid wastes	Identifies the type and lists amounts (cubic meters) of nonradioactive, nonhazardous solid wastes that would be generated during the construction or D&D
Radioactive Waste	Identifies the type (TRU, LLW, MLLW, GTCC, HAW, LAW, SBW) and lists amounts (cubic meters and curies) of radioactive wastes that would be generated during the construction or D&D
Hazardous/toxic chemical and wastes	Identifies the types and lists amounts (inventory/storage) of hazardous and toxic chemicals that could be present at the construction or D&D site, and amounts of hazardous wastes that would be generated
Pits and ponding created	Indicates if a new pit or pond would be used during construction or D&D and lists area(s) (square meters)
Water usage	Projects the total amount of water (liters) that would be used during construction or D&D
Energy requirements	Projects the amount of electricity (megawatt hours per year) and fossil fuels (liters) that would be needed during construction or D&D
Permits needed	Identifies any permits or licenses that would be necessary for construction

Parameter name	Explanation
	OPERATIONAL INFORMATION
Operation costs	Projects the operating cost of a project for a given period of time
Schedule	Provides start and end operation dates
Number of workers	Provides the projected number of workers (new and existing) that would be required for each year of operation; identifies the number of radiation workers (includes operations, maintenance, and support functions)
Average annual radiation worker radiation dose	Provides the expected average annual radiation dose (rem/year) for workers involved in the project operations
Heavy equipment	Defines equipment that would be used during operations and estimates heavy equipment traffic volumes (trips) to and from the operations site and their hours of operation
Air emissions	Identifies the type and lists quantities (Ci/year or tons/year) of air emissions to the environment during operations
Effluents	Identifies the types and lists amounts (liters per year) of liquid effluents that would be generated during operations
Solid wastes	Identifies the types and lists amounts (cubic meters per year) of nonradioactive, nonhazardous solid waste that would be generated during operations
Radioactive Waste	Identifies the type (TRU, LLW, MLLW, GTCC, HAW, LAW, SBW) and lists amounts (cubic meters and curies) of radioactive wastes that would be generated during operations (including spent HEPA filters)
Hazardous/toxic chemical and wastes	Identifies the types and lists amounts (inventory/storage) of hazardous and toxic chemicals that would be present at the operations site, and amounts of hazardous wastes that would be generated
Pits and ponding used	Indicates if a pit or pond would be used during operations, and lists area(s) (square meters)
Water usage	Projects the amount of water (liters per year) that would be used during operations
Energy requirements	Projects the amount of electricity (megawatt hours per year) and fossil fuels (liters per year) that would be needed for operations
Generators	Indicates if a new generator would be required during operations
Permits needed	Identifies any permits of licenses that would be necessary for operation

CERCLA Soil
Curie Information

DOE/ID-10534
November 1997

Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)

Binder 1 of 3

Idaho National Engineering Laboratory

U.S. Department of Energy • Idaho Operations Office

5.2.6 TRA Contaminant Sources

The influence of cross-gradient contaminant releases to the aquifer could potentially influence the measured aquifer contaminant concentrations downgradient from the ICPP. The Test Reactor Area (TRA) is relatively close. Although not directly upgradient from the ICPP, the locations of the TRA and ICPP are close enough that the contaminant plumes may merge downgradient from both facilities. Therefore, significant TRA releases to the aquifer are incorporated into the ICPP transport modeling.

Based on the TRA Remedial Investigation, chromium and tritium are the major risk drivers to the aquifer and the only contaminants that could significantly influence aquifer concentrations at the ICPP (Arnett, 1996). Therefore, chromium and tritium mass fluxes were obtained for incorporation into the ICPP transport modeling.

There are two TRA contaminant sources simulated, the TRA injection well and the Warm Waste Pond liquid disposal. Chromium was discharged to both the injection well and the Warm Waste Pond. Tritium was only disposed of to the Warm Waste Pond. The estimated chromium discharge to the injection well was 4.61 kg/d from Jan 1, 1964 through Dec. 31, 1972. The total chromium discharge to the injection well is estimated to be 13,478 kg. The chromium and tritium fluxes to the aquifer from the Warm Waste Pond disposal are 8,070 kg and 8,920 Ci, respectively.

These mass fluxes to the aquifer from the vadose zone are shown in Table 5-41 and include both historic fluxes and the future predicted fluxes. The flux is assumed to be zero after the year 2015 because no more water will be infiltrating into the TRA ponds so that the major water driving force will be gone. In reality, there will be continuing ambient infiltration, but it is assumed that the contaminant flux to the aquifer will be reduced to a negligible amount.

Table 5-41 Summary of the predicted TRA chromium and H-3 fluxes to the aquifer from the vadose zone.

Date	Average H-3 Flux	Average Chromium Flux	Date	Average H-3 Flux	Average Chromium Flux
(year)	(Ci/d)	(kg/d)	(year)	(Ci/d)	(kg/d)
1952	6.87e-04	3.46e-04	1984	6.42e-01	5.77e-01
1953	8.33e-03	2.75e-03	1985	5.75e-01	5.62e-01
1954	2.97e-02	9.81e-03	1986	5.09e-01	5.46e-01
1955	6.37e-02	2.32e-02	1987	4.35e-01	5.31e-01
1956	1.08e-01	4.32e-02	1988	3.82e-01	5.15e-01
1957	1.71e-01	6.95e-02	1989	3.74e-01	5.00e-01
1958	2.61e-01	1.01e-01	1990	3.56e-01	4.84e-01
1959	3.75e-01	1.38e-01	1991	3.36e-01	4.69e-01
1960	5.02e-01	1.78e-01	1992	3.52e-01	4.53e-01
1961	6.04e-01	2.23e-01	1993	3.82e-01	4.31e-01
1962	6.44e-01	2.71e-01	1994	3.57e-01	4.02e-01
1963	6.78e-01	3.24e-01	1995	2.67e-01	3.67e-01
1964	7.21e-01	3.80e-01	1996	1.83e-01	3.33e-01
1965	7.55e-01	4.37e-01	1997	1.25e-01	3.00e-01
1966	7.89e-01	4.90e-01	1998	8.53e-02	2.70e-01
1967	8.08e-01	5.36e-01	1999	5.89e-02	2.42e-01
1968	8.49e-01	5.74e-01	2000	4.09e-02	2.18e-01
1969	9.39e-01	6.04e-01	2001	2.86e-02	1.95e-01
1970	1.15e+00	6.28e-01	2002	2.01e-02	1.76e-01

Table 5-41 Summary of the predicted TRA chromium and H-3 fluxes to the aquifer from the vadose zone.

Date	Average H-3 Flux	Average Chromium Flux	Date	Average H-3 Flux	Average Chromium Flux
(year)	(Ci/d)	(kg/d)	(year)	(Ci/d)	(kg/d)
1971	1.32e+00	6.45e-01	2003	1.41e-02	1.58e-01
1972	1.24e+00	6.57e-01	2004	9.99e-03	1.42e-01
1973	1.03e+00	6.64e-01	2005	7.08e-03	1.28e-01
1974	8.24e-01	6.68e-01	2006	5.03e-03	1.16e-01
1975	7.01e-01	6.67e-01	2007	3.59e-03	1.04e-01
1976	6.60e-01	6.64e-01	2008	2.56e-03	9.41e-02
1977	6.54e-01	6.59e-01	2009	1.83e-03	8.50e-02
1978	6.00e-01	6.51e-01	2010	1.31e-03	7.68e-02
1979	5.00e-01	6.41e-01	2011	9.40e-04	6.95e-02
1980	4.34e-01	6.30e-01	2012	6.75e-04	6.29e-02
1981	4.06e-01	6.18e-01	2013	4.86e-04	5.69e-02
1982	4.65e-01	6.05e-01	2014	3.49e-04	2.71e-02
1983	6.02e-01	5.91e-01	2015 - on	0	0

Contaminant of Potential Concern

5.2.7 Summary Comparison of the Relative Magnitude of the COPC Sources

For purposes of this study, the contaminant sources have been discretized into known releases, service waste, contaminated soils, and releases to the aquifer from the TRA. Table 5-43 summarizes the total amount of mass or activity for each of the COPCs, from each of these sources. Table 5-42 presents a summary of the percentage of each of the contaminants that comes from each of the general sources. The tank farm known releases provide the vast majority of the Am-241, Cs-137, I-129, Total Pu, Sr-90, and Tc-99. The injection well provides most of the Np-237 and H-3. The soil contamination provides all of the arsenic and most of the mercury and Co-60. The TRA provides almost all of the chromium and much of the H-3. Overall, the tank farm known releases accounts for the majority of the contamination to the environment.

Table 5-42 Summary of the total mass or activity for each of the COPCs, from each of groundwater contamination sources.

COPCs	Units	Known Release: Tank Farm	Known Release: Other	Service Waste[1]: Injection Well	Service Waste[1]: SWPs	Soil Contamination	TRA	Total
Arsenic	kg	0	0	0	0	4.57E+02	0	4.57E+02
Chromium	kg	1.60E+01	0	0	0	1.20E+02	2.15E+04	2.17E+04
Mercury	kg	2.81E+01	0	4.00E+02	0	5.96E+02	0	1.02E+03
Am-241	Ci	1.10E+02	0	1.23E-01	0	9.05E-01	0	1.11E+02
Co-60	Ci	6.84E+01	0	1.24E+00	1.12E-02	1.06E+02	0	1.76E+02
Cs-137	Ci	2.68E+04	3.09E+02	2.58E+01	5.34E-01	2.68E+03	0	2.98E+04
H-3	Ci	1.85E+01	3.78E+02	2.01E+04	9.99E+02	0	8.92E+03	3.04E+04
I-129	Ci	7.05E-03	0	1.39E+00	8.20E-02	3.89E-02	0	1.52E+00
Np-237	Ci	2.16E-01	0	1.07E+00	0	1.33E-01	0	1.42E+00
Total Pu	Ci	1.18E+03	0	8.22E-01	6.92E-02	1.02E+01	0	1.19E+03
Sr-90	Ci	1.80E+04	3.09E+02	2.43E+01	2.95E-01	1.11E+03	0	1.94E+04

1. Time period over which the estimates are available (from RWMIS) varies by contaminant.

Table 5-42 Summary of the total mass or activity for each of the COPCs, from each of groundwater contamination sources.

COPCs	Units	Known Release: Tank Farm	Known Release: Other	Service Waste[1]: Injection Well	Service Waste[1]: SWPs	Soil Contamination	TRA	Total
Tc-99	Ci	2.58E+00	0	0	0	1.06E-01	0	2.69E+00
Total U	Ci	7.47E-01	0	2.69E-01	7.01E-02	9.40E-01	0	2.03E+00

1. Time period over which the estimates are available (from RWMIS) varies by contaminant.

Total = 46,180 Ci
for Am → U

Table 5-43 Summary of the percent (%[1]) mass or activity for each of the COPCs, from each of groundwater contamination sources.

COPCs	Source (%): Known Release: Tank Farm	Source (%): Known Release: Other	Source (%): Service Waste: Injection Well	Source (%): Service Waste: SWPs	Source (%): Soil Contamination	Source (%): TRA	Total[2]
Arsenic	0	0	0	0	100.00	0	100
Chromium	0.07	0	0	0	0.55	99.37	100
Mercury	2.74	0	39.06	0	58.2	0	100
Am-241	99.07	0	0.11	0.00	0.82	0	100
Co-60	38.94	0	0.71	0.01	60.35	0	100
Cs-137	89.89	1.04	0.09	0.00	8.99	0	100
H-3	0.06	1.24	66.08	3.28	0	29.33	100
I-129	0.46	0	91.57	5.40	2.56	0	100
Np-237	15.22	0	75.41	0	9.37	0	100
Total Pu	99.07	0	0.07	0.01	0.86	0	100
Sr-90	92.58	1.59	0.12	0.00	5.71	0	100
Tc-99	96.05	0	0	0	3.95	0	100
Total U	36.87	0	13.28	3.46	46.39	0	100

1. % mass = % activity for a given COPC with the exception of Total Pu and Total U which are given just in % activity.
2. for a given COPC, accumulating the percentage across the various sources results in 100% of the mass or activity.

INEL/EXT-97-00600

September 1997

Idaho National Engineering Laboratory

Waste Inventories/ Characterization Study

R. S. Garcia

LOCKHEED MARTIN

Table 12. Tank Farm Inventory- Chemical Compositions. [8, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 29, 31, 32, 33, 34, 35]

	Waste Tank	Units	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190	
	Waste Type		Sodium	Sodium	Sodium	Sodium	Sodium	Sodium	Sodium	Fluoride	Zirconium	Sodium	Heel	
	Tank Capacity	gallons	318,000	318,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	
	Volume of Liquid Waste	gallons	278,600	277,400	8,300	21,300	262,300	122,300	281,000	48,000	283,600	97,600	500	
	Percent Full	%	87.6%	87.2%	2.8%	7.1%	87.4%	40.8%	93.7%	16.0%	94.5%	32.5%	0.2%	
	Process Chemicals													
	Specific Gravity		1.262	1.156	1.214	1.225	1.256	1.262	1.173	1.155	1.306	1.124		
	Acid (H+)	M	1.14	1.8	0.81	1.93	0.43	1.53	1.49	1.884	2.651	2.62	0.023	
	Nitrate (NO_3)	M	4.56	3.68	4.38	4.79	4.63	5.16	2.93	3.20	5.85	6.47	0.018	
	Aluminum (Al)	M	0.63	0.22	1.2	0.62	0.81	0.68	0.35	0.51	0.828	1.036		
	Boron (B)	M	0.01	0.015	0.009	0.013	0.007	0.017	0.02	0.012	0.037	0.027		
m̄ = .0031	Cadmium (Cd)	M	0.0008	0.0052	0.002	0.0014	0.0002	<0.0019	0.0017	0.0049	0.009	0.006		Avg = 33.1×10⁻⁴ · 372 m/L
	Calcium (Ca)	M	0.034	0.044	0.0093	0.042	0.011	0.067	0.063	0.041	0.148	0.096		
	Chloride (Cl)	M	0.031	0.012	0.01	0.011	0.043	0.03	0.02	0.0021	0.0148	0.022	0.00034	
m̄ = .0051	Chromium (Cr)	M	0.0038	0.0029	0.0006	0.016	0.0021	0.0049		0.00225	0.0128	0.00585		Avg = 51.1×10⁻⁴ = 265.7
m̄ = .125	Fluoride (F/HF)	M	0.042	0.089	0.08	0.053	0.04	0.16	0.04	0.22	0.302	0.35	0.0074	Avg = .125 M; = 2500 mg/L
	Iron (Fe)	M	0.018	0.012	0.02	0.058	0.02	0.021	0.018	0.019	0.0535	0.035		
m̄ = .0010	Lead (Pb)	M	0.0014	0.001	0.00003	0.0015	0.0011	0.00092			0.00115			Avg = 10.14×10⁻⁴ M = 210.1
	Manganese (Mn)	M		0.013		0.013	0.0084	0.019				0.0029		
m̄ = .0029	Mercury (Hg)	M, mg/l	0.00097	0.00045	0.0044	0.0027	0.0015	0.0039		0.001, 150	0.0073, 1480	0.0036, 730		Avg = .0029 M = 581.7 /lite
m̄ = .0022	Molybdenum (Mo)	M		.00052	0.0	0.00069	0.0005	.00052				0.00052		
	Nickel (Ni)	M	0.0016	0.0012	0.00027	0.0068	0.0012	0.0015		0.0016	0.005	0.00048		
	Phosphate (PO_4)	M		0.0061	0.0025	0	0.024	0.0026			0.00035			
	Potassium (K)	M	0.18	0.14	0.003	0.096	0.13	0.19	0.16	0.019	0.142	0.149		
	Sodium (Na)	M	2	0.9	0.02	0.77	2	1.4	0.96	0.175	0.738	1.14		
	Sulfate (SO4)	M	0.032	0.024	0.028	0.066	0.071	0.043	0.033	0.010	0.0348	0.031		
	Zirconium (Zr)	M	<0.0011	0.0046	0.01	<0.0015	0	0.0096	0	0.023	0.0255	0.032		
	Undissolved Solids (UDS)	gm/l	0.63	0.17	0.89	2.34	1.61	4.8 b	5.05	1.99	2.16	6.43		

All data are as reported in References 8, 12 through 21.

Cd = .0031 mole/liter × 112.4 g/mole = 0.3484 g/liter | F = .125 × 19.0 = 2.375 g/liter | Hg = .0029 × 200.6 = 0.5817 g/liter

Cr = .0051 × 52 = 0.2652 g/liter | Pb = .0010 × 207.2 = 0.2072 g/liter | Ni = .0022 × 58.7 = 0.1291 g/liter

Table 16. Tank Farm Inventory—Radiological Activities, Compositions, and Heat Generation Rates.[14, 16, 18, 24, 29, 31, 32, 33, 34, 35]

Waste Tank	Units	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Waste Type		Sodium	Sodium	Sodium	Sodium	Sodium	Sodium	Sodium	Zirconium	Zirconium	Dilute	Heel
Tank Capacity	gallons	318,000	318,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Volume	gallons	278,600	277,400	8,300	21,300	262,300	122,300	281,000	48,000	283,600	97,600	500
Am-241	mCi/l	0.063	0.017		<0.064	0.062	0.079			0.058		
Sb-125	mCi/l		0.27	0.78				0.25	1.84			
Ce-144	mCi/l		4.3	41.71	2.4		5.4	2.2	2.54	24	5.41	0.24
Cs-134	mCi/l	0.12	1.1	41.35	1.4	0.03	0.38	2	0.24	1.6	0.54	0.34
Cs-137	mCi/l	30	30	651.35	230	24	110	38	72	364	161	15.79
Co-60	mCi/l		0.19		0.25		0.07	0.15	0.05	0.37	0.11	
Eu-154	mCi/l	0.00078	0.38	8.87	1.4	0.04	0.42	0.26	0.38	1.84	0.73	0.12
Eu-155	mCi/l		0.19	3.8	1.7				0.11	0.72	0.13	0.053
I-129	mCi/l	<.000014	<.00033		<0.012	0.0054	<0.039					
Np-237	mCi/l	0.0028	0.0024		<0.008	0.00046	0.0039			0.007		
Ni-63	mCi/l	0.026	0.046									
Pu-238	mCi/l	0.66	0.52		0.21		0.54			0.804		
Pu-239	mCi/l	0.095	0.021		0.074		0.065			0.121		
Plutonium (total Pu)	mCi/l			2.22		1.5			2.88	0.364		
Ru-106	mCi/l		1.9	10.85				0.69				
Sr-90	mCi/l	25	29	619.3	240	27	130	35	399.82	276	65.9	
Tc-99	mCi/l				0.017	0.0087		0.0078				
Tritium (H-3)	mCi/l	0.028	0.033	2.21	0.00023	0.03	0.02		0.21	0.14		
Uranium (U)	mg/l	78	76	32	130	58	86		16	121	79	
Zr-95	mCi/l				477.54		247.02			0.1		
Heat Generation Rate	W/m³	0.31	0.35	8.2	2.75	0.3	1.42	0.46	4.69	3.73	1.04	0.082
										670.02		16.54
		55.99	67.97	1,382.44		52.67		78.56	496.07		233.82	

Tank Farm Facility Estimated Solid Heel Content

Wednesday, January 28, 1998

To: R. A. Gavalya

Described below are the assumptions and methodology used to estimate the residual solids Curie content left in the tanks that will be grouted in-place.

The solids activity is based on the results from the "FINAL GAMMA ANALYSIS REPORT", Log #11 188 1983. This was the solids sample that was obtained from tank WM-185 in 1983. Due to decay of some of the shorter half-life nuclides and the low proportion of the other nuclides, the only isotope used from this sample result is Cs^{137}. Along with Cs^{137}, we also have Ba^{137m} in equilibrium plus approximately an equal quantity of Sr^{90} which has no associated gamma radiation.

Using the result for Cs^{137} of 3.1×10^{7} Disintegrations per Second per Gram, this equates to approximately 8.4×10^{-4} Curies per Gram of Cs^{137}.
Multiplying this result by three (X3) to account for the other two major nuclides results in a total of 2.5×10^{-3} Curies per Gram.
Assuming a density for the solids of 1.5, then the curie content would be 3.8×10^{-3} Ci/cc or 6.2×10^{-2} Ci/in^3.

In talking to Dave Machovec, he estimates that ten (10) of the tanks will have one inch or less of solids in them but one tank, WM-189, may have about four inches of solids in the bottom.

Using a diameter for the tanks of 50 ft. gives an area of 1964 ft^2 or 2.83×10^{5} in^2.

Then 2.83×10^{5} in^2 times (1" in depth) times (6.2×10^{-2} Ci/in^3) equals approximately 17,500 Ci in each of the 10 tanks and four times this amount, or 70,000 Ci in WM-189.

This adds up to a total estimated heel content of 245,000 Curies in the eleven main tanks in the Tank Farm.
Assuming that we will be able to jet or pump out 90% of these solids, that will leave approximately 24,500 Curies that will be grouted in-place.

These numbers are only gross approximations but should be good enough for a first cut estimate until individual tank sampling can be accomplished.

If I can be of any further help, please contact me at 6-4490.

Respectfully, G. C. (Mac) McCoy

COST REFERENCE GUIDE
FOR CONSTRUCTION EQUIPMENT

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COST REFERENCE GUIDE
FOR
CONSTRUCTION EQUIPMENT

The Standard Reference for
Estimating Owning and Operating Costs
for All Classes of Construction Equipment

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MIXERS

CARRIERS — TRANSIT MIX

NOTE: Examples listed are specifically manufactured for this usage.

Equipment Specifications					Hourly Ownership & Overhaul Expenses					Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
						Ownership		Overhaul										
Axle Configuration	GVW (Lbs.)	HP	CWT	Ship Cubes	Econ. Hours	Depr.	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
DIESEL POWERED																		
4 x 2	35,000	235	113.0	24	11,625	$5.48	$3.11	$1.37	$1.68	$2.20	$1.80	$5.99	$1.01	$2.73	....	$13.73	$25.37	
4 x 4	39,000	285	140.0	29	11,625	7.56	4.28	1.89	2.31	3.03	2.48	7.27	1.29	3.53	....	17.60	33.64	
6 x 4	78,000	250	194.0	41	11,625	7.87	4.46	1.97	2.40	3.15	2.58	6.38	1.22	4.59	....	17.92	34.62	
6 x 6	79,000	285	195.0	41	11,625	8.50	4.62	2.12	2.60	3.40	2.78	7.27	1.36	5.69	....	20.50	38.54	

"Ready-Mix" Truck

fuel consumption = $\frac{\$7.22}{hr} \times \frac{\text{gal diesel}}{\$.74}$

= 9.8 gal/hr

CONCRETE

CONCRETE WORKING EQUIPMENT

PUMPS — TRAILER MOUNTED

fuel Consumption = $5.28/hr x gal/$.74 = 7.14 gal/hr

Equipment Specifications					Hourly Ownership & Overhaul Expenses: Econ. Hours	Ownership: Depr.	Ownership: O'Head	Overhaul: Labor	Overhaul: Parts	Field Repair & Fuel Expenses: Labor	Field Repair & Fuel Expenses: Parts	Field Repair & Fuel Expenses: Elec./Fuel	Field Repair & Fuel Expenses: Lube	Field Repair & Fuel Expenses: Tires	Field Repair & Fuel Expenses: G.E.C.	Total Operating Cost/Hr.	Total Hourly Costs	Notes
Model (Yr. Disc.)	Capacity (Cu. Yd./Hr.)	HP	CWT	Ship Cubes														
DIESEL POWERED (Cont.)																		
PUMPIT																		
* Mini-Pumpit (1983)	18	22	19.0	1	11,195	$1.35	$.73	$.42	$.52	$.56	$.46	$.84	$.18	$.15	....	$2.19	$5.21	
* 20 TVS (1983)	20	73	N/A	N/A	11,195	2.87	1.58	.90	1.09	1.19	.97	2.80	.50	.30	....	5.76	12.18	
* 35 TVS (1983)	35	73	N/A	N/A	11,195	3.00	1.63	.94	1.15	1.24	1.02	2.80	.51	.30	....	5.87	12.59	
* 50 TVS (1983)	50	73	N/A	N/A	11,195	3.09	1.68	.97	1.18	1.28	1.05	2.80	.52	.40	....	6.05	12.97	
* 65 TVS (1983)	65	110	N/A	N/A	11,195	4.14	2.24	1.30	1.58	1.71	1.40	4.21	.74	.40	....	8.46	17.72	
* 80 TD (1983)	80	110	N/A	N/A	11,195	5.76	3.12	1.80	2.20	2.38	1.95	4.21	.86	.40	....	9.80	22.68	
* 80 TD-SHP (1983)	80	160	N/A	N/A	11,195	6.66	3.61	2.08	2.55	2.75	2.25	6.13	1.12	.40	....	12.65	27.55	
* 100N (1983)	100	210	N/A	N/A	11,195	6.84	3.67	2.14	2.61	2.83	2.31	8.04	1.32	.44	....	14.94	30.20	
* 150T (1983)	150	210	145.0	9	11,195	7.65	4.11	2.39	2.92	3.16	2.59	8.04	1.38	.44	....	15.61	32.68	
REINERT																		
* P-3 (1985)	40–50	89	40.0	2	11,195	3.15	1.71	.99	1.20	1.26	1.03	3.41	.57	.30	....	6.67	13.82	
* P-6 (1985)	90–100	210	100.0	6	11,195	5.62	3.02	1.76	2.15	2.24	1.84	8.04	1.22	.44	....	13.78	26.33	
* P-7000 HD45 (1986)	110	350	160.0	10	11,195	8.64	4.64	2.70	3.30	3.39	2.77	13.41	1.97	.44	....	21.98	41.26	
* P-8000 (1986)	140	350	160.0	10	11,195	8.73	4.69	2.73	3.33	3.42	2.80	13.41	1.97	.44	....	22.04	41.52	
SCHWING																		
BPA 250 HDD	42	63	66.0	4	11,195	3.96	2.15	1.24	1.51	1.50	1.23	2.41	.52	.30	....	5.98	14.82	
BPA 350 D	60	63	66.0	4	11,195	4.14	2.24	1.30	1.58	1.57	1.28	2.41	.53	.30	....	6.09	15.35	
BPA 650 HDD-15	62	152	98.0	6	11,195	6.48	3.51	2.03	2.48	2.45	2.00	5.82	1.03	.40	....	11.70	26.20	
BPA 650 HDD-18	89	152	98.0	6	11,195	6.30	3.38	1.97	2.41	2.38	1.95	5.82	1.02	.40	....	11.57	25.63	
BPA 750 RD	39	51	38.0	2	11,195	3.51	1.90	1.10	1.34	1.33	1.09	1.95	.45	.30	....	5.12	12.97	
BPA 901 D	135	152	98.0	6	11,195	6.66	3.57	2.08	2.55	2.52	2.06	5.82	1.06	.44	....	11.69	26.75	
BPA 3000 HDD-15	68	177	160.0	10	11,195	9.18	4.97	2.87	3.51	3.47	2.84	6.78	1.32	.44	....	14.85	35.38	
BPA 3000 HDD-20	118	177	160.0	10	11,195	9.18	4.93	2.87	3.51	3.47	2.84	6.78	1.32	.44	....	14.85	35.34	

* DISCONTINUED MODEL

TRACTORS & EARTHMOVING

MOTOR GRADERS

fuel consumption = $\frac{\$3.19}{hr} \times \frac{gal\ diesel}{\$.74} = 4.31\ gal/hr$

Equipment Specifications					Hourly Ownership & Overhaul Expenses					Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
						Ownership		Overhaul										
Model (Yr. Disc.)	Trans.	HP	CWT	Ship Cubes	Econ. Hours	Depr.	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
DIESEL POWERED (Cont.)																		
CATERPILLAR																		
120 "G"	8-Sp. PS	125	248.0	44	14,995	$6.96	$5.12	$2.18	$2.87	$3.29	$2.59	$3.19	$.96	$.57	$.26	$10.86	$27.81	
130 "G"	8-Sp. PS	135	266.0	47	14,995	8.01	5.89	2.51	3.07	3.79	2.99	3.44	1.10	.57	.30	12.19	31.67	
140 "G"	8-Sp. PS	150	292.0	52	14,995	8.85	6.51	2.77	3.39	4.19	3.30	3.83	1.22	.70	.33	13.57	35.09	
12 "G"	8-Sp. PS	135	289.0	51	14,995	8.74	6.43	2.74	3.35	4.14	3.26	3.44	1.17	.62	.33	12.96	34.22	
14 "G"	8-Sp. PS	180	398.0	70	17,530	10.99	9.34	3.75	4.58	5.74	4.53	4.59	1.68	1.86	.45	16.65	47.31	
16 "G"	PS	250	527.0	93	21,120	13.43	13.70	5.11	6.24	8.42	6.65	6.38	2.43	2.62	.67	27.17	65.65	
CHAMPION																		
710R	8-Sp. PS	135	271.0	48	14,995	6.27	4.61	1.96	2.40	2.97	2.34	3.44	.94	.62	.23	10.54	25.78	
710A	8-Sp. PS	135	271.0	48	14,995	6.67	4.91	2.09	2.56	3.16	2.49	3.44	.97	.62	.25	10.93	27.16	
* 715 (1983)	8-Sp. PS	144	279.0	49	14,995	6.35	4.67	1.99	2.43	3.47	2.73	3.67	1.07	.69	.27	11.90	27.34	
* 715A (1983)	8-Sp. PS	144	302.0	53	14,995	6.97	5.13	2.16	2.67	3.80	2.99	3.67	1.13	.69	.30	12.56	29.53	
720R	8-Sp. PS	152	303.0	54	14,995	6.75	4.97	2.12	2.59	3.20	2.52	3.88	1.03	.80	.25	11.68	28.11	
720A	8-Sp. PS	152	335.0	59	14,995	7.41	5.45	2.32	2.84	3.51	2.76	3.88	1.09	.80	.28	12.32	30.34	
730R	8-Sp. PS	180	325.0	58	14,995	7.32	5.39	2.30	2.81	3.47	2.73	4.59	1.16	.80	.27	13.02	30.84	
730A	8-Sp. PS	180	325.0	58	14,995	8.05	5.92	2.52	3.09	3.81	3.00	4.59	1.23	.80	.30	13.73	33.31	
740R	8-Sp. PS	210	340.0	60	14,995	8.35	6.14	2.62	3.20	3.95	3.11	5.36	1.33	.80	.31	14.66	35.17	
740A	8-Sp PS	210	340.0	60	14,995	8.86	6.64	2.79	3.40	4.21	3.31	5.36	1.38	.80	.33	15.39	37.01	
* 760R (1984)	8-Sp. PS	210	380.0	67	14,995	9.59	7.05	3.01	3.67	4.96	3.91	5.36	1.54	1.86	.39	17.82	41.14	
780R	8-Sp. PS	200	406.0	72	17,530	8.97	7.63	3.06	3.75	4.69	3.70	5.10	1.51	1.86	.37	17.03	40.44	
780A	8-Sp. PS	200	405.0	72	17,530	9.43	8.02	3.22	3.93	4.93	3.89	5.10	1.56	1.86	.39	17.53	42.13	
DEERE																		
670A	8-Sp. PS	85	200.0	35	14,995	5.43	3.99	1.70	2.08	2.57	2.02	1.67	.69	.57	.20	7.72	20.92	
* 670A (1985)	PS	125	265.0	47	14,995	6.82	5.02	2.14	2.61	3.47	2.73	3.19	1.02	.57	.27	11.25	27.84	
670B	PS	135	286.0	51	14,995	6.82	5.02	2.14	2.61	3.23	2.54	3.44	.99	.57	.25	11.02	27.61	

* DISCONTINUED MODEL

TRACTORS & EARTHMOVING

LOADERS — WHEEL (STANDARD)

Standard Bucket & ROPS Included

Fuel Consumption = $\frac{\$2.98}{hr} \times \frac{\text{gal diesel}}{\$.74} = 4.03\ \frac{\text{gal}}{hr}$

Equipment Specifications					Hourly Ownership & Overhaul Expenses					Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
						Ownership		Overhaul										
Model (Yr. Disc.)	Bucket Capacity	HP	CWT	Ship Cubes	Econ. Hours	Depr.	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
DIESEL POWERED (Cont.)																		
CATERPILLAR																		
IT12	1-1/4 Cu. Yd.	65	155.0	12	11,195	$5.30	$2.90	$1.22	$1.50	$2.03	$1.60	$1.79	$.55	$.57	$.26	$6.80	$17.72	
* IT18 (1987)	1-1/2 Cu. Yd.	85	185.0	14	11,825	6.36	3.68	1.55	1.90	2.67	2.12	2.35	.73	.57	.34	8.78	22.27	
IT18B	1-1/2 Cu. Yd.	95	201.0	15	11,825	6.78	3.92	1.65	2.02	2.74	2.17	2.62	.76	.63	.35	9.27	23.64	
* IT28 (1987)	2 Cu. Yd.	105	211.0	16	14,825	7.22	4.17	1.76	2.16	3.03	2.40	2.60	.81	.63	.38	9.75	25.05	
IT28B	2 Cu. Yd.	110	225.0	17	11,825	7.74	4.47	1.89	2.30	3.12	2.47	2.62	.83	.63	.40	10.07	26.47	
910	1-1/4 Cu. Yd.	65	140.0	11	11,195	5.06	2.77	1.17	1.43	1.93	1.53	1.79	.53	.57	.24	6.59	17.02	
916	1-1/2 Cu. Yd.	85	178.0	13	11,195	6.52	3.57	1.51	1.84	2.49	1.97	2.35	.70	.57	.32	8.40	21.84	
* 920 (1985)	1-1/2 Cu. Yd.	80	171.0	13	11,195	5.99	3.28	1.38	1.69	2.40	1.90	2.21	.66	.63	.30	8.10	20.44	
* 926 (1987)	2 Cu. Yd.	105	185.0	14	11,825	6.82	3.94	1.66	2.03	2.66	2.27	2.50	.77	.63	.36	9.39	23.84	
926E	2 Cu. Yd.	110	195.0	15	11,825	7.30	4.22	1.78	2.17	2.95	2.33	2.62	.80	.82	.37	9.89	25.36	
* 930 (1985)	2 Cu. Yd.	100	198.0	15	11,825	6.75	3.90	1.64	2.01	2.66	2.26	2.38	.76	.82	.36	9.44	23.74	
* 936 (1987)	2-1/2 Cu. Yd.	125	266.0	20	11,825	8.60	4.97	2.10	2.56	3.61	2.88	2.98	.96	.82	.46	11.69	29.92	
936E	2-1/2 Cu. Yd.	135	264.0	20	11,825	9.51	5.49	2.32	2.83	3.84	3.04	3.21	1.02	1.81	.49	13.41	33.56	
* 950B (1987)	3 Cu.Yd.	155	307.0	23	13,305	9.53	6.13	2.04	2.49	4.18	3.30	3.89	1.20	1.81	.53	14.71	34.90	
950E	3 Cu. Yd.	160	331.0	25	13,305	10.58	6.81	2.26	2.77	4.46	3.52	3.81	1.26	2.86	.56	16.47	38.89	
* 966D (1987)	4 Cu. Yd.	200	416.0	31	13,305	13.26	8.55	2.84	3.47	5.82	4.60	4.76	1.63	3.00	.74	20.55	46.89	
966E	4 Cu. Yd.	216	439.0	33	13,305	14.82	9.54	3.17	3.87	6.24	4.93	5.14	1.74	3.60	.79	22.64	54.04	
980C	5-1/4 Cu. Yd.	270	583.0	44	14,995	17.28	12.72	4.22	5.16	8.32	6.57	6.43	2.28	4.29	1.05	28.94	68.32	
980C Hi-Lift	5 Cu. Yd.	270	609.0	46	14,995	17.93	13.19	4.38	5.35	8.63	6.82	6.43	2.34	5.24	1.09	30.55	71.40	
988B	7 Cu. Yd.	375	887.0	67	17,530	21.95	18.66	5.68	6.94	11.47	9.06	8.93	3.32	7.78	1.45	41.99	95.22	
988B Hi-Lift	6-1/2 Cu. Yd.	375	944.0	71	17,530	22.43	19.07	5.81	7.10	11.72	9.26	8.93	3.38	7.78	1.48	42.52	96.93	
992C	13-1/2 Cu. Yd.	690	1,921.0	144	21,120	37.83	38.59	11.76	14.36	23.72	18.73	16.42	6.67	20.46	3.00	89.00	191.53	
992C Hi-Lift	12 Cu. Yd.	690	2,194.0	165	21,120	39.00	39.78	12.11	14.80	24.45	19.31	16.42	6.83	20.46	3.09	90.56	196.25	

* DISCONTINUED MODEL

TRACTORS & EARTHMOVING

TRACTOR — LOADER — BACKHOE

Standard Buckets & ROPS Included

fuel Consumption = $\frac{\$1.81}{hr} \times \frac{\text{gal diesel}}{\$.74} = 2.45\ \text{gal/hr.}$

Equipment Specifications							Hourly Ownership & Overhaul Expenses	Ownership		Overhaul		Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
Model (Yr. Disc.)	Loader Bucket Capacity	Backhoe Bucket Width	Digging Depth	HP	CWT	Ship Cubes	Econ. Hours	Depr.	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
DIESEL POWERED																				
ALLIS-CHALMERS *Refer to CDS, INC. for current models.*																				
* 714C (1984)	7/8 Cu. Yd.	24"	14' 2"	65	128.0	10	11,195	$3.68	$2.06	$.90	$1.09	$1.55	$1.21	$1.87	$.47	$.22	$.21	$5.53	$13.26	
* 715C (1984)	7/8 Cu. Yd.	24"	14' 2"	65	132.0	10	11,195	3.82	2.13	.93	1.13	1.61	1.26	1.87	.49	.22	.21	5.66	13.67	
BENATI																				
Ben 2000 G53	1.4 Cu. Yd.	25-1/2"	17' 8"	87	220.0	17	11,195	6.63	3.70	1.61	1.96	2.53	1.99	2.51	.71	.65	.34	8.73	22.63	
CDS, INC. *Refer to ALLIS-CHALMERS for other models.*																				
714C	7/8 Cu. Yd.	24"	14' 2"	66	128.0	10	11,196	4.43	2.47	1.08	1.31	1.69	1.33	1.87	.50	.23	.23	5.85	15.14	
715C	7/8 Cu. Yd.	24"	15' 2"	66	132.0	10	11,196	4.72	2.63	1.14	1.40	1.80	1.42	1.87	.52	.23	.24	6.06	15.97	
CASE																				
* 480D (1986)	7/8 Cu. Yd.	24"	12' 0"	47	97.0	7	10,560	3.55	1.90	.82	1.00	1.32	1.03	1.36	.36	.26	.18	4.52	11.79	
480E-2WD	7/8 Cu. Yd.	24"	12' 0"	51	97.0	7	10,560	3.27	1.75	.76	.92	1.19	.93	1.47	.37	.26	.16	4.38	11.06	
480E-4WD	7/8 Cu. Yd.	24"	12' 0"	51	109.0	8	10,560	3.86	2.07	.89	1.09	1.40	1.10	1.47	.41	.29	.19	4.86	12.77	
* 580D (1984)	1 Cu. Yd.	24"	14' 0"	55	113.0	8	11,195	4.32	2.41	1.05	1.29	1.60	1.42	1.58	.49	.21	.24	5.74	14.60	
* 580 Super D (1984)	1 Cu. Yd.	24"	14' 7"	60	115.0	9	11,195	4.66	2.60	1.13	1.38	1.96	1.53	1.73	.53	.21	.26	6.21	15.96	
580 Super E-2WD	1 Cu. Yd.	24"	14' 7"	63	117.0	9	11,195	4.27	2.38	1.04	1.27	1.63	1.28	1.81	.48	.26	.22	5.68	14.64	
580 Super E-4WD	1 Cu. Yd.	24"	14' 7"	63	129.0	10	11,195	4.80	2.68	1.17	1.42	1.84	1.44	1.81	.52	.29	.24	6.14	16.21	
580K-2WD	1 Cu. Yd.	24"	14' 4"	63	N/A	N/A	11,195	4.17	2.33	1.01	1.24	1.59	1.26	1.81	.47	.26	.21	5.59	14.34	
580K-4WD	1 Cu. Yd.	24"	14' 4"	63	133.0	10	11,195	4.72	2.63	1.15	1.40	1.80	1.42	1.81	.51	.29	.24	6.07	16.97	
* 680H (1986)	1-1/2 Cu. Yd.	24"	16' 6"	80	158.0	12	11,195	6.37	3.56	1.55	1.89	2.49	1.95	2.30	.66	.46	.33	8.22	21.59	

* DISCONTINUED MODEL

HYDRAULIC CRANES

SELF-PROPELLED

Equipment Specifications							Hourly Ownership & Overhaul Expenses					Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
								Ownership		Overhaul*										
Model (Yr. Disc.)	Axle Config.	Boom Range	Lift Capacity (Tons)	HP	CWT	Ship Cubes	Econ. Hours	Depr.*	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
DIESEL POWERED (Cont.)																				
P & H (Cont.)																				
* Omega 18 (1983)	(4x2)	27' 0"-80' 0"	18	125	368.0	51	13,305	$9.33	$5.89	$3.93	$4.81	$4.22	$3.46	$3.44	$1.19	$.71	....	$13.02	$36.98	
* Omega 18 (1983)	(4x4)	27' 0"-80' 0"	18	125	368.0	51	13,305	9.67	6.10	4.08	4.99	4.37	3.59	3.44	1.22	.71	....	13.33	38.17	
* Omega 20 (1983)	(4x2)	25' 2"-43' 2"	20	125	375.0	52	13,305	8.77	5.54	3.70	4.52	3.97	3.25	3.44	1.14	.71	....	12.51	35.04	
* Omega 20 (1983)	(4x4)	25' 2"-43' 2"	20	125	379.0	52	13,305	9.15	5.78	3.86	4.72	4.14	3.40	3.44	1.17	.71	....	12.86	36.37	
* Omega 20 (1983)	(4x2)	26' 3"-62' 3"	20	125	375.0	52	13,305	9.13	5.77	3.85	4.71	4.13	3.39	3.44	1.17	.71	....	12.84	36.30	
* Omega 20 (1983)	(4x4)	26' 3"-62' 3"	20	125	375.0	52	13,305	9.49	5.99	4.00	4.89	4.29	3.52	3.44	1.20	.71	....	13.16	37.53	
* Omega 20 (1983)	(4x2)	27' 0"-80' 0"	20	125	375.0	52	13,305	9.63	6.06	4.06	4.97	4.36	3.58	3.44	1.21	.71	....	13.30	38.04	
* Omega 20 (1983)	(4x4)	27' 0"-80' 0"	20	125	375.0	52	13,305	9.97	6.30	4.21	5.14	4.51	3.70	3.44	1.25	.71	....	13.61	39.23	
* Omega 23 (1983)	(4x2)	26' 0"-62' 0"	23	125	414.0	57	13,305	10.01	6.32	4.22	5.16	4.53	3.71	3.44	1.25	1.03	....	13.96	39.67	
* Omega 23 (1983)	(4x4)	26' 0"-62' 0"	23	125	414.0	57	13,305	10.38	6.55	4.38	5.35	4.70	3.85	3.44	1.28	1.03	....	14.30	40.96	
* Omega 23 (1983)	(4x2)	27' 0"-80' 0"	23	125	414.0	57	13,305	10.27	6.48	4.33	5.30	4.65	3.81	3.44	1.27	1.03	....	14.20	40.58	
* Omega 23 (1983)	(4x4)	27' 0"-80' 0"	23	125	414.0	57	13,305	10.71	6.76	4.52	5.52	4.84	3.97	3.44	1.31	1.03	....	14.69	42.10	
Omega 25	(4x4)	32' 0"-80' 0"	25	155	533.0	74	14,995	14.09	10.16	6.34	7.75	6.67	5.47	4.26	1.77	1.76	....	19.93	58.27	
Omega 30	(4x4)	32' 0"-80' 0"	30	155	533.0	74	14,995	14.50	10.46	6.53	7.96	6.87	5.64	4.26	1.81	1.76	....	20.34	59.81	
Omega 35	(4x4)	32' 0"-80' 0"	35	155	533.0	74	14,995	14.93	10.77	6.72	8.21	7.07	5.80	4.26	1.85	1.76	....	20.74	61.37	
Omega 40	(4x4)	32' 6"-106' 0"	40	202	724.0	100	14,995	20.27	14.62	9.12	11.15	9.60	7.88	5.56	2.49	2.81	....	28.34	83.50	
Omega 45	(4x4)	32' 6"-106' 0"	45	202	753.0	104	14,995	20.96	15.14	9.44	11.54	9.94	8.16	5.56	2.55	3.34	....	29.54	86.64	
Omega 50	(4x4)	32' 6"-106' 0"	50	202	724.0	100	14,995	21.60	15.58	9.72	11.88	10.23	8.39	5.56	2.61	3.34	....	30.13	88.91	
Omega 65	(4x4)	38' 0"-114' 0"	65	235	945.0	130	14,995	27.76	20.03	12.49	15.27	13.15	10.79	6.46	3.29	4.02	....	37.71	113 26	
* Omega 114 (1985)	(4x2)	25' 0"-62' 0"	14-1/2	128	435.0	60	13,305	9.42	5.94	3.97	4.86	4.10	3.36	3.52	1.17	1.25	....	13.40	37.59	
* Omega 114 (1986)	(4x4)	25' 0"-62' 0"	14-1/2	128	403.0	56	13,305	10.50	6.63	4.43	5.42	4.56	3.75	3.52	1.27	1.25	....	14.35	41.33	
Century 114	(4x4)	25' 0"-62' 0"	14-1/2	128	435.0	60	14,150	11.67	7.79	5.21	6.36	5.11	4.20	3.52	1.38	1.25	....	15.46	46.39	
* Omega 114D (1986)	(4x4)	24' 0"-42' 6"	14-1/2	128	403.0	56	13,305	9.17	5.79	3.87	4.73	3.99	3.28	3.52	1.15	1.03	....	12.97	36.53	
* Omega 114D (1986)	(4x4)	29' 0"-72' 0"	14-1/2	128	451.0	62	13,305	9.85	6.22	4.15	5.06	4.26	3.51	3.52	1.21	1.03	....	13.55	38.65	
Century 114D	(4x4)	25' 0"-62' 0"	14-1/2	128	403.0	56	13,305	11.06	6.99	4.68	5.71	4.69	3.77	3.52	1.27	1.03	....	14.16	42.64	
* Omega 115 (1985)	(4x2)	24' 0"-42' 6"	15	128	435.0	60	13,305	9.42	5.94	3.97	4.86	4.10	3.36	3.52	1.17	1.03	....	13.16	37.37	
* Omega 115 (1986)	(4x4)	25' 0"-62' 0"	15	128	435.0	60	13,305	10.50	6.63	4.43	5.42	4.56	3.75	3.52	1.27	1.03	....	14.13	41.11	
* Omega 115 (1985)	(4x2)	29' 0"-72' 0"	15	128	463.0	67	13,305	10.06	6.36	4.26	5.20	4.38	3.60	3.52	1.23	1.03	....	13.76	39.65	
Century 115	(4x4)	25' 0"-62' 0"	15	128	435.0	60	14,150	11.67	7.79	5.21	6.36	5.11	4.20	3.52	1.38	1.26	....	15.46	46.39	

* DISCONTINUED MODEL

$$gal/hr = \frac{gal}{\$} \times \frac{\$}{hr}$$

$$= \frac{gal}{\$.74} \times \frac{\$3.44}{hr}$$

fuel Consumption $= 4.65\ gal/hr$

TRUCKS
LIGHT DUTY

Equipment Specifications					Hourly Ownership & Overhaul Expenses					Field Repair & Fuel Expenses						Total Operating Cost/Hr.	Total Hourly Costs	Notes
						Ownership		Overhaul										
Axle Configuration	Ton Rating	HP	CWT	Ship Cubes	Econ. Hours	Depr.	O'Head	Labor	Parts	Labor	Parts	Elec./Fuel	Lube	Tires	G.E.C.			
GASOLINE POWERED																		
Conventional																		
4x2	1/2	130	39.0	13	6,335	$1.43	$.47	$.16	$.19	$.25	$.20	$2.15	$.28	$.13	....	$3.01	$5.26	
4x2	3/4	130	40.0	14	6,335	1.75	.57	.19	.24	.31	.25	2.15	.29	.13	....	3.13	5.88	
4x2	1	180	43.0	15	6,335	1.88	.61	.20	.25	.33	.27	2.97	.38	.13	....	4.08	7.02	
Crew Cab																		
4x2	3/4	130	47.0	16	6,335	1.92	.63	.21	.28	.34	.27	2.15	.30	.13	....	3.19	6.21	
4x2	1	180	48.0	16	6,335	2.17	.71	.24	.29	.38	.31	2.97	.39	.13	....	4.18	7.59	
Conventional																		
4x4	1/2	130	43.0	15	7,605	1.38	.52	.18	.21	.29	.23	2.15	.29	.09	....	3.05	5.34	
4x4	3/4	130	45.0	15	7,605	1.67	.63	.22	.28	.35	.28	2.15	.30	.09	....	3.17	5.95	
4x4	1	180	49.0	17	8,450	1.67	.70	.24	.30	.39	.31	2.97	.39	.09	....	4.15	7.06	
Crew Cab																		
4x4	3/4	180	55.0	19	7,605	2.03	.77	.26	.32	.42	.34	2.97	.40	.13	....	4.26	7.64	
DIESEL POWERED																		
Conventional																		
4x2	1/2	75	39.0	13	8,450	1.40	.59	.24	.29	.25	.20	.65	.14	.13	....	1.37	3.89	
4x2	3/4	75	40.0	14	8,450	1.65	.69	.28	.35	.29	.23	.65	.16	.13	....	1.48	4.43	
4x2	1	130	43.0	15	8,450	1.74	.73	.30	.36	.31	.25	1.13	.20	.13	....	2.02	5.15	
4x4	3/4	130	45.0	15	8,450	1.81	.67	.31	.38	.32	.25	1.13	.21	.09	....	2.00	5.17	
4x4	1	130	49.0	17	8,450	2.00	.84	.34	.42	.35	.28	1.13	.22	.09	....	2.07	5.67	

COST FORMULAS

III. Overhaul & Field Repair (Parts & Labor)

3.1 These costs, as estimated in the Cost Reference Guide, are relative to the economic life of the equipment. If, for example, the economic life is shortened due to severe working conditions, then overhaul and repair reserve funds must be accrued at a faster rate. Therefore, the same multiplier used for depreciation in paragraph 1.1 can be applied to these costs, both parts and labor:

$$\frac{\text{average economic hours}}{\text{adjusted economic hours}} = \text{Multiplier}$$

This principle does not apply if the economic life is adjusted for tax accounting purposes or for any other reason except actual job conditions.

3.2 Actual overhaul and field repair costs increase with equipment age, regardless of job conditions. The Cost Reference Guide calculates these costs by assuming a steady accrual of funds that will be used when needed. This means that the amount accrued in earlier stages of equipment life will be more than immediately needed, but will be offset by the higher funds needed toward the later stages of equipment life.

3.3 The following table of multipliers can be used to derive overhaul and field repair costs during extended economic life periods. They apply to both the average costs shown in the Cost Reference Guide and any adjusted cost.

Multipliers

Extended Life Hours	Track Type Equipment	Rubber Tire Equipment
To 5,000	1.10	1.07
5,000 - 8,000	1.15	1.12
8,000 - 12,000	1.22	1.18
12,000 & Over	1.31	1.25

3.4 For adjustments and comparisons, the average labor cost per hour can be related to the following average mechanic's wage (including fringe benefits):

$23.30 (1988 Sections)
$23.30 (1989 Sections)

3.5 For adjustments and comparisons, the following breakdown of the cost for labor can be used:

Base wages	= 60%
Fringe benefits	= 32%
Supervision, shop supplies, service facilities, etc.	= 8%
	100% Total labor cost

IV. Fuel/Electric Costs

4.1 To adjust the fuel costs shown in Cost Reference Guide to reflect the local cost of fuel:

$$\frac{\text{local cost per gal.}}{\text{CRG cost per gal.}} = \text{Multiplier}$$

CRG Fuel Costs (gal.):	1988 Sections	1989 Sections
Diesel	$ .74	$ .74
Gasoline	$ .86	$ .88

4.2 To adjust electricity costs shown in Cost Reference Guide to reflect the local cost of electricity:

$$\frac{\text{local cost per kw}}{\text{CRG costs per kw}} = \text{Multiplier}$$

CRG Electric Costs per kw hr:

$.064 (1988 Sections)
$.064 (1989 Sections)

INEEL/EXT-97-01428

December 1997

TRU Separations Options Scoping Study Report

W. H. Landman, Jr.
C. M. Barnes

Sodium Bearing Waste Processing

Note: 1 grout batch per month, see below for batch time	Grout Solid Additives	Denitrated Waste	Grout Tank Exhaust	Exhaust Return	Exhaust Filter Solids	Grout Decon Effluent	Grouted Waste
Stream Number	544	549	550	551	552	553	554
Flow Rate, Kg/h	6,132	2,628					12,263
M3 per 2-yr campaign							2,992
	kg/month	kg/month					kg/month
Al2O3		13,567					13,567
NaAlO2		24,110					24,110
K2SO4		1,426					1,426
KAlO2		2,011					2,011
Ca3(PO4)2		294					294
CaO		585					585
CaF2		479					479
NaNO3		4,393					4,393
Fe2O3		305					305
ZrO2		47					47
B2O3		307					307
NaCl		262					262
AgO		0.5					0.51
As2O3		0.9					0.90
BaO		1.7					1.67
CdO		66					66
Cr2O3		38					38
Cs2O		0.3					0.27
MnO		121					121
NiO		16					16
PbO		41					41
SeO2		0.5					0.53
UO2		1.2E-09					1.2E-09
HgO		10					9.7
Portland Cement	37,397						37,397
Blast Furnace Slag	37,397						37,397
Flyash	37,397						37,397
Water of Hydration							64,108
Hours per batch (processing time only, 1 batch per month)							18.3

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Alumina Calcine Processing

Note: 1 batch per month,see below for hours per batch	Grout Tank Exhaust	Exhaust Return	Exhaust Filter Solids	Grout Decon Effluent	Grouted Waste		
Stream Number	550	551	552	553	554		
Flow Rate, kg/h					12,263		
Volume, m3 per 6 yr					7,240		
					Wt %		
Al2O3					9.06		
B2O3					0.07		
Cs2O					0.00		
Fe2O3					0.02		
HgO					0.20		
KNO3					0.02		
NaNO3					0.65		
AlPO4					0.12		
Al2(SO4)3					0.26		
AlF3					0.31		
Portland Cement					20.24		
Blast Furnace Slag					20.24		
Flyash					20.24		
Water of Hydration					28.57		
O2							
N2							
Hours per batch (1 batch per month)					14.8		

Zirconia Calcine Processing

Note: 1 batch per month,see below for hours per batch	Grout Tank Exhaust	Exhaust Return	Exhaust Filter Solids	Grout Decon Effluent	Grouted Waste		
Stream Number	550	551	552	553	554		
Flow Rate,kg/h					12,263		
Volume, m3 per 6 yr					12,439		
					Wt %		
Al2O3					3.08		
B2O3					0.52		
CaO					0.71		
CaF2					12.18		
Cr2O3					0.08		
Fe2O3					0.12		
KNO3					0.18		
MgO					0.12		
NaNO3					1.48		
ZrO2					2.91		
Others					0.05		
Portland Cement					16.67		
Blast Furnace Slag					16.67		
Flyash					16.67		
Water of Hydration					28.57		
O2							
N2							
Hours per batch (1 batch per month)					10.9		

ENGINEERING DESIGN FILE

Project File Number 02BF0

Project/Task Waste Treatment Project Feasibility Studies

Subtask Vitrification Facility

Title:	Electrical Requirements
Summary:	This EDF evaluated the electrical requirements for the Vitrification Facility. The connected loads were estimated to be 2.6 MVA, an evaluation of the usage indicated that the demand would be approximately 2.0 MVA. The majority of the demand is from the melters. The Bath Electrode requires a source of standby power. The estimated standby requirement is 800 kVA. The standby power system at the ICPP is presently undergoing a complete redesign and the final configuration and spare capacity is not known. It would be safe to assume that a new standby generator would needed. This generator would be installed in the existing standby generator building and would be connected to the Substation 60 which distributes standby power to the ICPP. Normal power would be supplied from Substaion 15 via two existing Power Sectionalizing Switches. These switches are located in the northeast quadrant of the ICPP and would supply a 13.8kV feed to the new load center. The load center would supply a secondary voltage of 480 Volts for building and process loads. Standby power would be supplied through this load center from Substation 60.

Distribution (complete package):

Distribution (summary package only):

Author	Dept.	Reviewed	Date	Approved	Date
John E. Duggan	AEDL	[signature]	12-17-97	[signature]	12/18/97
		LMITCO Review	Date	LMITCO Approval	Date

See Management Control Procedure (MCP) 6 for instructions on use of this form.

TABLE 1

WASTE TREATMENT PROJECT
FEASIBILITY STUDIES

CONNECTED LOAD
VITRIFICATION FACILITY

LOAD	kVA
General Building Lighting 215,576 sq. Ft @ 1.75 Watts per sq. Ft = 377,258 Watts	377
Miscellaneous Loads 215,576 sq. Ft. @ 1.0 Watts per sq. Ft = 215,576 Watts	216
HVAC Loads: Supply Fan Motors 3@75 HP 3@50HP Exhaust Fan Motors 3@100 HP Miscellaneous HVAC 150 HP small Motors	 225 150 300 150
Process Equipment: Melters Bath Electrode 1@ 500 kW Lid Heater 1@450 kW Pumps, Blowers and Conveyors 170 HP Cranes 70 HP	 500 450 170 70
Total connected kVA	2,568

Appendix B

Major Laws, Regulations, Orders, and Agreements

CONTENTS

EIS MAJOR LAWS

B-1. TANK FARM CLOSURE REGULATORY REQUIREMENTS

This section identifies and summarizes the major laws, regulations, executive orders, and U.S. Department of Energy (DOE) orders that may apply to the Resource Conservation and Recovery Act (RCRA) Closure of the Tank Farm Facility (TFF) with follow-on use as a near-surface disposal area licensed by the Nuclear Regulatory Commission (NRC). For consistency, the format from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F) has been used and updated as necessary. Updated information associated with DOE orders, the Environmental Impact Statement (EIS) Record of Decision (ROD), Consent Orders, and special requirements associated with this project has been provided.

The discussion includes the major federal statutes that impose environmental protection and compliance requirements upon DOE (Section 2.1–2.24), as well as those state and local measures applicable to the proposed action because federal law delegates enforcement or implementation authority to state or local agencies (Section 2.27). Section 2.25 addresses environmentally related presidential executive orders that clarify issues of national policy and set guidelines under which federal agencies, including DOE, must act. The DOE implements its responsibilities for protection of public health, safety, and the environment through a series of departmental orders that are mandatory for operating contractors of DOE facilities (Section 2.26).

Based on an assessment of available project information and the environmental requirements, Section B-2.29 provides a table identifying the environmental permits, licenses, and assessments that may be required for the RCRA Closure of the TFF.

B-2. FEDERAL ENVIRONMENTAL STATUTES AND REGULATIONS

B-2.1 National Environmental Policy Act of 1969, as amended (42 USC §4321 et seq.)

The National Environmental Policy Act (NEPA) establishes a national policy promoting awareness of the environmental consequences of major federal activities on the environment and promoting consideration of the environmental impacts during the planning and decision-making stages of a project. NEPA requires all agencies of the federal government to prepare a detailed statement on the environmental effects of proposed major federal actions that may significantly affect the quality of the human environment.

The Council on Environmental Quality and DOE have promulgated regulations for implementing NEPA (40 CFR Parts 1500–1508 and 10 CFR Part 1021). (DOE 1995, Vol. 2, Part A, Section 7.2.1.1).

B-2.2 Atomic Energy Act of 1954, as amended (42 USC §2011 et seq.)

The Atomic Energy Act of 1954 authorizes the DOE to establish standards to protect health or minimize dangers to life or property (42 USC §2011 et seq.) with respect to activities under its jurisdiction. Through a series of DOE orders, the DOE has established an extensive system of standards and requirements to ensure safe operation of its facilities. (DOE 1995, Vol. 2, Part A, Section 7.2.1.2).

B-2.3 Clean Air Act, as amended (42 USC §7401 et seq.)

The Clean Air Act, as amended, is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act, as amended, requires that each Federal agency, such as DOE, with jurisdiction over any property or facility that might result in the discharge of air pollutants, comply with "all Federal, State, interstate, and local requirements" with regard to the control and abatement of air pollution.

The law requires the U.S. Environmental Protection Agency (EPA) to establish national primary and secondary ambient air quality standards as necessary to protect public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 USC §7409). The Clean Air Act also requires establishment of (a) national standards of performance for new stationary sources of atmospheric pollutants; (b) emissions limitations for any new or modified building, structure, facility, or installation that emits or may emit an air pollutant (42 USC §7411); and (c) standards for emission of hazardous air pollutants (42 USC §7412). In addition, the Clean Air Act requires specific emission increases to be evaluated so as to prevent a significant deterioration in air quality. (42 USC §7470).

To comply with these requirements, the EPA issued: (a) Primary and Secondary National Ambient Air Quality Standards, including standards for emissions of sulfur dioxide, oxides of nitrogen, carbon monoxide, particulate matter with a diameter of less than or equal to 10 micrometers (PM-10), ozone, and lead (40 CFR Part 50); (b) the Standards of Performance for New Stationary Sources within specific source categories enumerated in 40 CFR Part 60.16, including electric steam-generating units, industrial-commercial-institutional steam-generating units, and stationary gas turbines (40 CFR Part 60); (c) the National Emission Standard for Hazardous Air Pollutants, including radionuclides (40 CFR Part 61 and 40 CFR Part 63); and (d) the Prevention of Significant Deterioration of Air Quality review regulations. (40 CFR Part 52.21).

The Clean Air Act requires each state to develop and submit for approval to the EPA implementation plans to control air pollution and air quality in that state. Under EPA regulations, Idaho has been delegated authority under the Clean Air Act to maintain the Primary and Secondary National Ambient Air Quality Standards (40 CFR Part 52, Subpart N), to issue permits under the Prevention of Significant Deterioration (40 CFR Part 52.683), and to enforce performance standards for new stationary sources. The entire Idaho National Engineering and Environmental Laboratory (INEEL) facility is treated as a single pollutant source and, therefore, is a major stationary source for Prevention of Significant Deterioration review. To date, the State of Idaho does not have authority to administer the National Emission Standards for Hazardous Air Pollutants program regulating emissions of radionuclides at DOE facilities. Therefore, National Emission Standards for Hazardous Air Pollutants approvals authorizing release of radionuclides are obtained from the EPA Region 10. However, the state does regulate radionuclides under its Prevention of Significant Deterioration program and, therefore, DOE coordinates any National Emission Standards for Hazardous Air Pollutants approvals obtained from the EPA with the State of Idaho to fulfill applicable requirements of the state's Prevention of Significant Deterioration program.

On November 15, 1990, the Clean Air Act Amendments were signed into law. Under these amendments, new standards will be imposed on major sources emitting air pollutants in nonattainment areas, and states will have to submit new State Implementation Plans to address these new requirements. Mobile sources of air pollutants, such as cars, trucks, buses, and certain off-the-road engines, also will have to meet new standards. (DOE 1995, Vol. 2, Part A, Section 7.2.1.3).

B-2.4 Clean Water Act, as amended (33 USC §1251 et seq.)

The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the Clean Water Act, as amended, requires all branches of the federal government engaged in any activity that might result in a discharge or runoff of pollutants to surface waters to comply with federal, state, interstate, and local requirements.

In addition to setting water quality standards for the nation's waterways, the Clean Water Act supplies guidelines and limitations for effluent discharges from point-source discharges, and provides authority for the EPA to implement the National Pollutant Discharge Elimination System permitting program. The National Pollutant Discharge Elimination System program is administered by the Water Management Division of the EPA pursuant to regulations in 40 CFR Part 122 et seq. Idaho has not applied for National Pollutant Discharge Elimination System authority from the EPA. Thus, all National Pollutant Discharge Elimination System permits required for the INEEL would be obtained by DOE through the EPA Region 10. (40 CFR Part 122 et seq.).

Sections 401 and 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act. Section 402(p) requires that the EPA establish regulations for issuing permits for storm water discharges associated with industrial activity. Storm water discharges associated with industrial activity are permitted through the National Pollutant Discharge Elimination System. General permit requirements are published in 40 CFR Part 122. (DOE 1995, Vol. 2, Part A, Section 7.2.1.4).

B-2.5 Safe Drinking Water Act, as amended (42 USC §300f et seq.)

The primary objective of the Safe Drinking Water Act, as amended, is to protect the quality of the public water supplies and all sources of drinking water. The implementing regulations are found in 40 CFR Part 141, National Interim Primary Drinking Water Regulations. These regulations, administered by the EPA unless delegated to the states, establish standards applicable to public water systems. They promulgate maximum contaminant levels, including those for radioactivity, in community water systems, which are defined as public water systems that serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. For radionuclides, the regulations specify that the average annual concentration of beta particle and photon radioactivity from manmade radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 0.004 Rem (4 mrem)/yr. The maximum contaminant level for gross alpha particle activity is 15 picocuries per liter. The EPA proposed revisions to regulating radionuclides in drinking water on July 18, 1991. The proposed rule has not been finalized. For purposes of analysis, however, the more conservative standards were used. Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program. The Snake River Plain Aquifer, a portion of which flows beneath the INEEL, has been designated by the EPA as a sole source aquifer pursuant to the Sole Source

Aquifer Program. The State of Idaho has received authorization from the EPA to implement the public drinking water system program and the underground injection control program under the Safe Drinking Water Act. (DOE 1995, Vol. 2, Part A, Section 7.2.1.5).

B-2.6 Resource Conservation and Recovery Act, as amended (42 USC §6901, et seq.)

The treatment, storage, or disposal of hazardous and nonhazardous waste is regulated under the Solid Waste Disposal Act, as amended by the RCRA and the Hazardous and Solid Waste Amendments of 1984. Pursuant to Section 3006 of the Act, any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply for EPA authorization of its program. The EPA regulations implementing RCRA are found in 40 CFR Parts 260–280. These regulations define hazardous wastes and specify hazardous waste transportation, handling, treatment, storage, and disposal requirements.

The regulations imposed on a generator or a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements. (DOE 1995, Vol. 2, Part A, Section 7.2.1.6).

B-2.7 Federal Facility Compliance Act (42 USC §6921 et seq.)

The Federal Facility Compliance Act, enacted on October 6, 1992, waives sovereign immunity for fines and penalties for RCRA violations at federal facilities. However, the effective date of the waiver has been delayed for 3 years for mixed waste storage prohibition violations, as long as the federal facility is in compliance with all other applicable requirements of RCRA. During this 3-year period, DOE is required to prepare plans for developing the required treatment capacity for mixed wastes stored or generated at each facility. Each plan must be approved by the host state or the EPA, after consultation with other affected states, and a Consent Order must be issued by the regulator requiring compliance with the plan. The Federal Facility Compliance Act further provides that the DOE will not be subject to fines and penalties for land disposal restriction storage prohibition violations for mixed waste as long as it is in compliance with such an approved plan and Consent Order and meets all other applicable regulations. (DOE 1995, Vol. 2, Part A, Section 7.2.1.8).

B-2.8 Comprehensive Environmental Response, Compensation, and Liability Act, as amended (42 USC §9601 et seq.)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, provides a statutory framework for the cleanup of waste sites containing hazardous substances and as amended by the Superfund Amendments and Reauthorization Act provides an emergency response program in the event of a release (or threat of a release) of a hazardous substance to the environment. Using the Hazard Ranking System, federal and private sites are ranked and may be included on the National Priority List. CERCLA, as amended, requires such federal facilities having such sites to undertake investigations and remediation as necessary. The act also includes requirements for reporting releases of certain hazardous substances in excess of specified amounts to state and federal agencies. (DOE 1995, Vol. 2, Part A, Section 7.2.1.9).

B-2.9 Emergency Planning and Community Right-to-Know Act of 1986 (42 USC §11001 et seq.) (also known as "SARA Title III")

Under Subtitle A of this Act, federal facilities, including those owned by the DOE, provide various information such as inventories of specific chemicals used or stored and releases that occur from these sites, to the state Emergency Response Commission and to the Local Emergency Planning Committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this act began voluntarily in 1987, and inventory and annual emissions reporting began in 1988, based on 1987 activities and information. The DOE also requires compliance with Title III as a matter of agency policy.

In addition, under Subtitle B of the Act, Material Safety Data Sheets Reports (SARA §311), Emergency and Hazardous Chemical Inventory Reports, (Superfund Amendments and Reauthorization Act, §312), and Toxic Chemical Release Inventory Reports (Superfund Amendments and Reauthorization Act §313), must be provided to appropriate state, local, national, and federal authorities. Executive Order 12856 requires federal facilities to adhere to the same planning and reporting provisions of federal right-to-know and pollution prevention laws that cover private industry. (DOE 1995, Vol. 2, Part A, Section 7.2.1.10).

B-2.10 Hazardous and Radioactive Materials Transportation Regulations

Transport of hazardous and radioactive materials, substances, and wastes are governed by U.S. Department of Transportation (DOT), NRC, and EPA regulations. These regulations may be found in 49 CFR Parts 100–178, 10 CFR Part 71, and 40 CFR Part 262, respectively.

DOT regulations contain requirements for identification of a material as hazardous or radioactive. These regulations may hand off to NRC or EPA regulations for identification of material. However, DOT hazardous material regulations govern the hazard communication (for example, marking, hazard labeling, vehicle placarding, and emergency response telephone number) and transport requirements, such as required entries on shipping papers or EPA waste manifest.

NRC regulations applicable to radioactive materials transportation are found in 10 CFR Part 71 and detail packaging design requirements, including the testing required for package certification. Complete documentation of design and safety analysis as well as results of the required testing is submitted to the NRC for certification of the package for use. This certification testing involves the following components: heat, physical drop onto an unyielding surface, water submersion, puncture by dropping a package onto a rigid spike, and gas tightness. Some of the testing is designed to simulate maximum credible accident conditions.

EPA regulations pertaining to hazardous waste transportation are found in 40 CFR Part 262. These regulations deal with the use of the EPA waste manifest, which is the shipping paper used when transporting RCRA hazardous waste. (DOE 1995, Vol. 2, Part A, Section 7.2.1.11).

B-2.11 National Historic Preservation Act, as amended (16 USC §470 et seq.)

The National Historic Preservation Act, as amended, provides that sites with significant national historic value be placed on the National Register of Historic Places. There are no permits or certifications required under the Act. However, if a particular federal activity may impact a historic property resource, consultation with the Advisory Council on Historic Preservation will usually generate a Memorandum of Agreement, including stipulations that must be followed to minimize adverse impacts. Coordination with the State Historic Preservation Officer is also undertaken to ensure that potentially significant sites are properly identified and appropriate mitigative actions implemented. (DOE 1995, Vol. 2, Part A, Section 7.2.1.12).

B-2.12 Archaeological Resource Protection Act, as amended (16 USC §470 et seq.)

This act provides for the preservation of historical and archaeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as the result of (a) flooding, the building of access roads, the erection of workmen's communities, the relocation of railroads and highways, and other alterations of the terrain caused by the construction of a dam, by any agency of the United States, or by any private person or corporation holding a license issued by any such agency or (b) any alteration of the terrain caused as a result of any Federal construction project or federally licensed activity or program. The law also requires that, whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistorical, historical, or archaeological data, the agency must notify the U.S. Department of Interior (DOI) and may request DOI to undertake the recovery, protection, and preservation of such data. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed are to remain the property of the United States. Consent must be obtained from the Indian tribe owning lands on which a resource is located before issuance of a permit, and the permit must contain terms or conditions requested by the tribe. (DOE 1995, Vol. 2, Part A, Section 7.2.1.13).

B-2.13 Endangered Species Act, as amended (16 USC §1531 et seq.)

The Endangered Species Act, as amended, is intended to prevent the further decline of endangered and threatened species and to restore these species and their habitats. The act is jointly administered by the U.S. Departments of Commerce and the Interior. Section 7 of the act requires consultation to determine whether endangered and threatened species are known to have critical habitats on or in the vicinity of the proposed action. (DOE 1995, Vol. 2, Part A, Section 7.2.1.14).

B-2.14 Migratory Bird Treaty Act, as amended (16 USC §703 et seq.)

The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying the mode of harvest, hunting seasons, bag limits, and so forth. The act stipulates that it is unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the DOI to relocate a nest that interferes with resource development or recovery operations. (DOE 1995, Vol. 2, Part A, Section 7.2.1.15).

B-2.15 Noise Control Act of 1972, as amended (42 USC §4901 et seq.)

Section 4 of the Noise Control Act of 1972, as amended, directs all federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. (DOE 1995, Vol. 2, Part A, Section 7.2.1.16).

B-2.16 Toxic Substance Control Act (15 USC §2601 et seq.)

This act provides the EPA with the authority to require testing of both new and old chemical substances entering the environment and to regulate them where necessary. The Toxic Substances Control Act (TSCA) came about as a result of concerns that there were no general federal regulations for the thousands of new chemicals developed each year for their potential environmental or health effects before their introduction to the public or into commerce. TSCA also regulates the treatment, storage, and disposal of certain toxic substances not regulated by RCRA or other statutes, specifically polychlorinated biphenyls (PCBs), cholorofluorocarbons (CFCs), asbestos, dioxins, certain metal-working fluids, and hexavalent chromium. The asbestos regulations under the TSCA were ultimately overturned. However, regulations pertaining to asbestos removal, storage, and disposal are promulgated through the National Emission Standard for Hazardous Air Pollutants Program (40 CFR Part 61, Subpart M). For CFCs, Title VI of the Clean Air Act Amendments of 1990 requires a reduction of CFCs beginning in 1991, and prohibits production beginning in 2000. (DOE 1995, Vol. 2, Part A, Section 7.2.1.17).

B-2.17 American Indian Religious Freedom Act of 1978 (42 USC §1996)

This act reaffirms Native American religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. The act requires that federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions. (DOE 1995, Vol. 2, Part A, Section 7.2.1.18).

B-2.18 Native American Graves Protection and Repatriation Act of 1990 (25 USC §3001)

This law directs the Secretary of Interior to guide responsibilities in repatriation of federal archaeological collections and collections held by museums receiving federal funding that are culturally affiliated to Native American tribes. Major actions to be taken under this law include: (a) establishing a review committee with monitoring and policy-making responsibilities; (b) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (c) overseeing museum programs designed to meet the inventory requirements and deadlines of this law; and (d) developing procedures to handle unexpected discoveries of graves and/or grave goods during activities on federal or tribal land. (DOE 1995, Vol. 2, Part A, Section 7.2.1.19).

B-2.19 Nuclear Waste Policy Act (42 USC §10101 et seq.)

The act authorizes the federal agencies to develop a geologic repository for the disposal of high-level radioactive waste and spent nuclear fuel from commercial reactors. The act specifies the process for selecting a repository site and constructing, operating, closing, and decommissioning the repository. The law also establishes programmatic guidance for these activities. (DOE 1995, Vol. 2, Part A, Section 7.2.1.20).

In 1974, Congress passed the Energy Reorganization Act, which authorized the NRC to regulate and license DOE facilities constructed for the expressed purpose of long-term storage and disposal of high-level radioactive waste, which is not part of DOE's research and development program. The NRC has established regulations for radioactive waste that can be disposed of in land disposal sites (10 CFR Part 61), as well as radioactive waste requiring geologic disposal (10 CFR Part 60). The EPA was authorized to establish standards for managing and disposing of spent nuclear fuel, high-level waste (HLW), and transuranic waste. These regulations are contained in 40 CFR Part 191 and would apply to HLW disposal.

The Energy Reorganization Act authorized NRC to license the following specific classes of DOE facilities:

1. Demonstration liquid metal fast breeder reactors when operated as part of the power generation facilities of an electric utility system or when operated in any other manner to demonstrate the suitability of such a reactor for commercial application.

2. Other demonstration nuclear reactors except those in existence on the effective date of the act when operated as part of the power generation facilities of an electric utility system or when operated in any other manner to demonstrate the suitability of such a reactor for commercial application.

3. Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under the act.

4. Retrievable surface storage facilities and other facilities authorized for long-term storage of high-level radioactive waste generated by the Administration [ERDA], which are not used for, or part of, research and development activities.

The Energy Reorganization Act also established the goal of efficient energy utilization while enhancing environmental protection and created the position of Assistant Administrator for Environment and Safety.

The Department of Energy Organization Act of 1977 clarified Congressional intent related to DOE's environmental functions. It states:

- The Department of Energy, by consolidating environmental considerations and procedures now within the separate purview of the Federal Energy Administration (FEA), Energy Research and Development Administration (ERDA), Federal Power Commission (FPC), and part of the U.S. Department of Interior (DOI), should provide an effective vehicle for identifying potential environmental, health, safety, socioeconomic, institutional, and control technology issues associated with technology development. It will provide a single, coordinated mechanism for determining necessity and timing of environmental impact assessments and environmental impact statements in order to respond to the needs of specific technologies or resources. It will ensure a complete and fully integrated program with respect to environmental, health, and safety impact research and engineering applications.

This authorized the establishment of eight Assistant Secretaries, including one with environmental responsibilities and functions. The duties of the latter included advising the Secretary on how well DOE's activities conform to environmental protection laws and principles. Section 102, the Congressional declaration of purpose, listed some of DOE's fundamental purposes as ensuring incorporation of national environmental protection goals in the formulation and implementation of energy programs; advancing the goals of restoring, protecting, and enhancing environmental quality; and ensuring public health and safety. The final regulations implementing the AEA statute and related legislation are found in Title 10 of the CFR. (Office of Environmental Policy and Assistance, Department of Energy, http://tis-nt.eh.doe.gov/oepa/law_sum/AEA.HTM).

B-2.20 Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240)

This law establishes two major national policies: (1) each state is responsible for ensuring adequate disposal capacity for the low-level commercially generated waste generated within its own borders, with the exception of waste generated by federal defense or research and development activities; and (2) the required disposal facilities can best be provided through regional groupings of states allied through interstate agreements called compacts. A compact ratified by a group of states must be approved by Congress before it takes full effect. (DOE 1995, Vol. 2, Part A, Section 7.2.1.21).

B-2.21 Occupational Safety and Health Act of 1970, as amended (29 USC § 651 et seq.)

The Occupational Safety and Health Act establishes standards to enhance safe and healthful working conditions in places of employment throughout the United States. The act is administered and enforced by the Occupational Safety and Health Administration (OSHA), which is a U.S. Department of Labor agency. While OSHA and the EPA both have a mandate to reduce exposures to toxic substances, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment. In general, under the act, it is the duty of each employer to furnish all employees a place of employment free of recognized hazards likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and all rules, regulations, and orders issued under the act. OSHA regulations (published in Title 29 of the Code of Federal Regulations) establish specific standards telling employers what must be done to achieve a safe and healthful working environment. DOE places emphasis on compliance with these regulations at DOE facilities and prescribes through DOE orders the OSHA standards that contractors shall meet, as applicable to their work at government-owned, contractor-operated facilities (DOE Orders 5480.1B and 5483.1A). DOE keeps and makes available the various records of minor illnesses, injuries, and work-related deaths as required by OSHA regulations. (DOE 1995, Vol. 2, Part A, Section 7.2.1.22).

B-2.22 Religious Freedom Restoration Act of 1993 (42 USC §2000bb et seq.)

This act prohibits the government, including federal departments, from substantially burdening the exercise of religion unless the government demonstrates a compelling governmental interest and the action furthers a compelling government interest and is the least restrictive means of furthering that interest. (DOE 1995, Vol. 2, Part A, Section 7.2.1.23).

B-2.23 Bald and Golden Eagle Protection Act, as amended (16 USC §668–668d)

This act makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the DOI to relocate a nest that interferes with resource development or recovery operations. (DOE 1995, Vol. 2, Part A, Section 7.2.1.24).

B-2.24 Pollution Prevention Act of 1990 (42 USC §13101 et seq.)

The Pollution Prevention Act of 1990 establishes a national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and, lastly, disposal. Disposal or releases to the environment should only occur as a last resort. In response, DOE has committed to participation in the Superfund Amendments and Reauthorization Act Section 313, EPA 33/50 Pollution Prevention Program. The goal, for facilities already involved in Section 313 compliance, is to achieve a 33 % reduction in the release of 17 priority chemicals by 1997 from a 1993 baseline. On August 3, 1993, Executive Order 12856 was issued, expanding the 33/50 program such that DOE must reduce its total releases of all toxic chemicals by 50 % by December 31, 1999. DOE is also requiring each DOE site to establish site-specific goals to reduce generation of all waste types. At the INEEL, reduction/recycling programs and goals have been established for all wastes. In addition to the 33/50 goals, a zero generation goal for hazardous waste has tentatively been set for 2010. (DOE 1995, Vol. 2, Part A, Section 7.2.1.25).

B-2.25 Executive Orders

B-2.25.1 Executive Order 12088 [Federal Compliance with Pollution Control Standards (October 13, 1978), as amended by Executive Order 12580 (January 23, 1987)]

Federal Compliance with Pollution Control Standards requires federal agencies, including the DOE, to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, Noise Control Act, Clean Water Act, Safe Drinking Water Act, TSCA (15 USC §2061 et seq.), and RCRA. (DOE 1995, Vol. 2, Part A, Section 7.2.2.1).

B-2.25.2 Executive Order 11593 (May 13, 1971) (National Historic Preservation)

This order requires federal agencies, including DOE, to locate, inventory, and nominate properties under their jurisdiction or control to the National Register of Historic Places if those properties qualify. This process requires the DOE to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed resources. (DOE 1995, Vol. 2, Part A, Section 7.2.2.2).

B-2.25.3 Executive Order 11514 (NEPA)

This order requires federal agencies to continually monitor and control their activities to protect and enhance the quality of the environment and to develop procedures to ensure that fullest practicable provision of timely public information and understanding of the federal plans and programs with environmental impact to obtain the views of interested parties. The DOE has issued regulations (10 CFR Part 1021) and DOE Order 451.1 for compliance with this Executive Order.

B-2.25.4 Executive Order 12580 (Superfund Implementation)

This order delegates to the heads of executive departments and agencies the responsibility for undertaking remedial actions for releases, or threatened releases that are not on the National Priority List and removal actions other than emergencies where the release is from any facility under the jurisdiction or control of executive departments and agencies. (DOE 1995, Vol. 2, Part A, Section 7.2.2.4).

B-2.25.5 Executive Order 11988 (Floodplain Management)

This order requires federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable. (DOE 1995, Vol. 2, Part A, Section 7.2.2.5).

B-2.25.6 Executive Order 11990 (Protection of Wetlands)

This order requires governmental agencies to avoid, to the extent practicable, any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative. (DOE 1995, Vol. 2, Part A, Section 7.2.2.6).

B-2.25.7 Executive Order 12898 (Environmental Justice)

This order directs federal agencies to achieve environmental justice by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The order creates an Interagency Working Group on Environmental Justice and directs each federal agency to develop strategies within prescribed time limits to identify and address environmental justice concerns. The order further directs each federal agency to collect, maintain, and analyze information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations, when such facilities or sites become the subject of a substantial federal environmental administrative or judicial action, and to make such information publicly available. (DOE 1995, Vol. 2, Part A, Section 7.2.2.7).

B-2.25.8 Executive Order 12344 (Naval Nuclear Propulsion Program) [enacted as permanent law by Public Law 98-525 (42 USC 7158)]

This order prescribes the authority and responsibility of the Naval Nuclear Propulsion Program, a joint Navy/DOE organization, for all matters pertaining to naval nuclear propulsion. These responsibilities include all environmental and occupational safety and health aspects of the program. (DOE 1995, Vol. 2, Part A, Section 7.2.2.8).

B-2.25.9 Executive Order 12856 (Right-to-Know Laws and Pollution Prevention Requirements)

This order requires all federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and accident notification; and encourage clean technologies and testing of innovative prevention technologies. The order also provides that federal agencies are persons for purposes of the Emergency Planning and Community Right-to-Know Act (SARA Title III), which obliges agencies to meet the requirements of the act. (DOE 1995, Vol. 2, Part A, Section 7.2.2.9).

B-2.25.10 Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions)

This order declares that federal agencies are required to prepare environmental analyses for "major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the ocean or Antarctica)." According to the Executive Order, major federal actions significantly affecting the environment of foreign countries may also require environmental analyses under certain circumstances. The procedural requirements imposed by the Executive Order are analogous to those under the National Environmental Policy Act. (DOE 1995, Vol. 2, Part A, Section 7.2.2.10).

B-2.26 Department of Energy Regulations and Orders

Through the authority of the Atomic Energy Act, DOE is responsible for establishing comprehensive programs at its facilities to protect health, safety, and the environment. Formerly, DOE carried out this responsibility by directing the activities of its employees and contractors with a series of DOE orders. Since August 1994, DOE has begun shifting to a system of regulations and directives, in a standards-based management approach, to ensure the excellence in performance that DOE expects of its employees and contractors. Directives include orders, policy statements, contractor requirements documents, and manuals to give advice on how to implement requirements. A necessary and sufficient process will be used by DOE and its contractor to decide what directives apply to a particular facility, activity, or site. [Final Environmental Impact Statement for the Tank Waste Remediation System. April, 1996 (DOE/EIS-0189)].

DOE regulations generally are found in Volume 10 of the Code of Federal Regulations. These regulations address such areas as energy conservation, administrative requirements and procedures, and classified information. For purposes of this activity, relevant subchapters include Part 835, "Occupational Radiation Protection"; Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Radioactive Waste"; Part 1021, "Compliance with the National Environmental Policy Act"; and Part 1022, "Compliance with Floodplains/Wetlands Environmental Review Requirements. "

DOE orders generally set forth policy and the programs and procedures for implementing that policy. The following sections provide a brief discussion of selected orders.

B-2.26.1 DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees

This order establishes requirements and procedures to ensure that occupational safety and health standards prescribed pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, and the DOE Organization Act of 1977, provide occupational safety and health protection for DOE contractor employees in government-owned contractor-operated facilities that is consistent with the protection afforded private industry employees by the occupational safety and health standards promulgated under the Occupational Safety and Health Act of 1970.

B-2.26.2 DOE Order 231.1, Environment, Safety, And Health Reporting

The objective of this order is to ensure collection and reporting of information on environment, safety, and health that is required by law or regulation to be collected, or that is essential for evaluating DOE operations and identifying opportunities for improvement needed for planning purposes within the DOE.

B-2.26.3 DOE Order 232.1, Occurrence Reporting And Processing Of Operations Information

This order establishes the requirements for reporting and processing occurrences relating to safety, health, security, property, operations, and environment up to and including emergencies.

B-2.26.4 DOE Order 451.1, National Environmental Policy Act Compliance Program

This order establishes responsibilities and sets forth procedures necessary for implementing the National Environmental Policy Act of 1969, as amended, to operate each of its facilities in full compliance with the letter and spirit of the act.

B-2.26.5 DOE Order 5480.1B, Environment, Safety, and Health Program for Department of Energy Operations

This order establishes the Environment, Safety, and Health Program for DOE operations.

B-2.26.6 DOE Order 5480.3, Safety Requirements For The Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes

This order provides DOE policy, sets forth requirements, and assigns responsibilities for the safe transport of hazardous materials, hazardous substances, hazardous wastes, and radioactive materials.

B-2.26.7 DOE Order 5700.6C, Quality Assurance

This order provides DOE policy, sets forth requirements, and assigns responsibilities for establishing, implementing, and maintaining plans and actions to ensure quality achievement in DOE programs. Requirements from this order for nuclear facilities were also issued April 5, 1994, under 10 CFR Part 830.120, "Quality Assurance."

B-2.26.8 DOE ORDER 5820.2A, Radioactive Waste Management

This order establishes policies and guidelines by which the DOE manages its radioactive waste, waste by-products, and radioactively contaminated surplus facilities. Specific requirement limits include (a) external exposure to waste and concentrations of radioactive material that may be released into surface water, groundwater, soil, plants, or animals and is limited to an effective dose equivalent not to exceed 25 mrem/yr to any member of the public; and (b) atmospheric releases that are required to comply with the limits specified in 40 CFR 61. Limits are imposed on the cumulative effective dose received by an individual intruder at any time after 100 years, when there is an assumed loss of active institutional control. DOE's historic planning strategy has been to dispose of the majority of their HLW in a national repository. However, DOE does not view disposal in a national repository as being legally required, and DOE intends to determine the appropriate disposition of HLW on a case-by-case basis. For purposes of disposal, DOE Order 5820.2A differentiates between new and readily retrievable existing HLW and HLW that is not readily retrievable. The order provides for new and readily retrievable existing waste to be processed and the HLW fraction disposed of in a geologic repository. For HLW that is not readily retrievable, the order provides for evaluation of such methods as in-place stabilization as well as possible retrieval and processing as stated for new and readily retrievable HLW.

B-2.26.9 DOE Order 5400.1, General Environmental Protection Program

This order establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with applicable federal, state, and local environmental protection laws and regulations as well as internal DOE policies.

B-2.26.10 DOE Order 5400.5, Radiation Protection Of The Public and The Environment

This order establishes standards and requirements for operation of the DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation. The requirements of this order are being codified in the proposed 10 CFR Part 834, Radiation Protection of the Public and the Environment.

B-2.26.11 DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards

This order specifies and provides requirements for the application of the mandatory environmental, safety, and health standards applicable to all DOE and DOE contractor operations.

B-2.26.12 DOE Order 5480.10, Contractor Industrial Hygiene Program

This order establishes the requirements and guidelines applicable to DOE contractor operations for maintaining an effective industrial hygiene program to preserve employee health and well-being.

B-2.26.13 DOE Order 5480.11, Radiation Protection For Occupational Workers

This order establishes radiation protection standards and program requirements for the DOE and DOE contractor operations with respect to the protection of the worker from ionizing radiation.

B-2.26.14 DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements

This order establishes the requirements and procedures for the reporting of information having environmental protection, safety, or health protection significance for DOE operations.

B-2.26.15 DOE Order 6430.1A, General Design Criteria

This order establishes requirements for construction of DOE facilities. Section 0285–2.2.2, "Environmentally Sensitive Areas," identifies that "the following environmentally sensitive areas shall be avoided or receive lowest siting priority for TSD of hazardous, nonhazardous, and radioactive solid waste: Wetlands; Areas within the 500-year floodplain; Permafrost areas; Critical habitats of endangered species; Recharge zones of sole-source aquifers; and Watersheds for domestic water supply."

B-2.27 Nuclear Regulatory Commission Regulations and Guidance

Subject to future agreements between DOE and NRC, the placement of a radioactively-contaminated grout in the TFF may be regulated by the NRC as a near-surface disposal facility for radioactive waste. Current NRC regulations associated with near-surface disposal is found in 10 CFR 61 "Licensing Requirements For Land Disposal Of Radioactive Waste." NRC guidance associated with the requirements for radioactive waste disposal that may apply to the TFF are found in the documents identified below. This is a partial list as these documents also reference other regulatory guides.

1. NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility"

2. NUREG-1200, "Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility"

3. NUREG-1300, "Environmental Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility"

4. Reg. Guide 1.132, Rev. 1, "Site Investigations for Foundations of Nuclear Power Plants"

5. Reg. Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants"

6. Reg. Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed In Light-Water-Cooled Nuclear Power Plants"

7. Reg. Guide 4.18, "Standard Format and Content of Environmental Reports for Near-Surface Disposal of Radioactive Waste"

8. Reg. Guide 4.19, "Guidance for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste."

B-2.28 Idaho Laws and Regulations

The Idaho Environmental Protection and Health Act (Idaho Code, Title 39, Chapter 101 et seq.) establishes general provisions for the protection of the environment and public health. The act created the Idaho Department of Health and Welfare and its subordinate Division of Environmental Quality, thus consolidating all state public health and environmental protection activities under one department. The Idaho Department of Health and Welfare is authorized to implement these environmental, health, and social services requirements. The act authorizes the department to promulgate standards, rules, and regulations relating to water and air quality, noise reduction, and solid waste disposal and grants authority to issue required permits, collect fees, establish compliance schedules, and review plans for the construction of sewage and public water treatment and disposal facilities.

Authorization is also granted to the Idaho Department of Health and Welfare by the Idaho Water Pollution Control Act (Idaho Code, Title 39, Chapter 36) for the protection of the waters of Idaho. General language concerning the prevention of water pollution and the provision of financial assistance to municipalities is contained in the law.

The Idaho Department of Health and Welfare is also responsible for enforcement and implementation of the Hazardous Waste Management Act of 1983, as amended (Idaho code, Title 39, Chapter 44), which provides for the protection of health and the environment from the effects of improper or unsafe management of hazardous wastes and for the establishment of a tracking or manifesting system for these wastes. This program is intended to be consistent with and not more stringent than federal regulations as established under the RCRA. At this time, Idaho has primacy over hazardous and mixed waste promulgated by the EPA. The Hazardous Waste Management Act sets forth requirements for the development of plans that address identification of hazardous wastes, unauthorized treatment, storage, release, use, or disposal of these wastes, and permit requirements for hazardous waste facilities. Rules and regulations concerning the transportation, monitoring, reporting, and record keeping of hazardous wastes have also been promulgated by the Idaho Department of Health and Welfare under authority of this act. (DOE 1995, Vol. 2, Part A, Section 7.2.4).

The following sections discuss the major requirements and regulations pursuant to these state laws.

B-2.28.1 Idaho Air Pollution Control Regulations

Pursuant to the Rules and Regulations for the Control of Air Pollution in Idaho (Idaho Administrative Procedures Act Title 1, Chapter 1), the Department of Health and Welfare established ambient air quality standards for particulate matter, sulfur dioxide, ozone, oxides of nitrogen, carbon monoxide, and fluorides.

Title 1, Chapter 1, of the Rules and Regulations for the Control of Air Pollution in Idaho is intended to provide authority and standards in compliance with the Clean Air Act. The Department of Health and Welfare has been granted authority to implement the requirements of the Clean Air Act and to adopt rules to implement the requirements of the Clean Air Act for that purpose. These rules and regulations include provisions for establishing compliance schedules and emission limits, reporting and correction of emissions that exceed established limits, and permitting requirements for construction and operation of facilities or activities that may generate emissions in excess of the prescribed standards. The Prevention of Significant Deterioration, control of open burning, and fugitive dust are addressed by these rules, as are specified types of facilities that may exceed emission limits. Also required by the Idaho Air Pollution Control Regulations is the formulation of a plan for the prevention and alleviation of air pollution emergencies. The plan includes definitions of the severity of the emergency, requirements for public notification, and recommended actions to be taken in abating an air pollution emergency. (DOE 1995, Vol. 2, Part A, Section 7.2.4.1).

B-2.28.2 Idaho Water Quality Standards and Wastewater Treatment Requirements and Wastewater Land Application Permit Regulations

Provisions are set forth by these regulations (Idaho Department of Health and Welfare, Rules and Regulations, Title 1, Chapter 2) for protection of designated water uses and the establishment of water quality standards that will protect those uses. The Department of Health and Welfare has been authorized to develop and enforce these regulations by Section 39-105 of the Idaho Code. Restrictions are outlined by these regulations for control of point-source and nonpoint-source discharges and other activities that may adversely affect waters of the State of Idaho, including surface water and groundwater. These regulations identify water-use classifications, specifically prohibited discharges, water quality criteria, and requirements for treatment of wastewater before discharge in the waters of Idaho. In addition, state regulations require that a permit be obtained for the application of wastewater to the land surface. (DOE 1995, Vol. 2, Part A, Section 7.2.4.2).

B-2.28.3 Idaho Regulations for Public Drinking Water Systems

Maximum contaminant levels for public drinking water systems are provided by these regulations. The Water Quality Bureau, as a subdivision of the Department of Health and Welfare, sets forth monitoring and reporting requirements for inorganic and organic chemicals and radiochemicals. Other water quality and locational standards are also included in these regulations. The department reserves the authority to determine whether the contamination is caused by nuclear facilities and to require further monitoring. (DOE 1995, Vol. 2, Part A, Section 7.2.4.3).

B-2.28.4 Idaho Hazardous Waste Management Regulations

Pursuant to the Hazardous Waste Management Act, the Department of Health and Welfare (Title 1, Chapter 5) has adopted by reference the federal regulations regarding hazardous waste rulemaking, hazardous waste delisting, and identification of wastes. Included in these regulations are requirements for hazardous waste generators, transporter, and management facilities as well as detailed procedures for permitting these activities. The general requirements for generators, transporters, and management facilities have been incorporated by reference; however, some sections have been revised to reflect Idaho's permitting program. Section 39-4404 (14) of the act identifies "restricted hazardous waste" that includes liquid hazardous wastes containing specified concentrations of constituents as well as hazardous wastes containing concentrations of halogenated compounds. (DOE 1995, Vol. 2, Part A, Section 7.2.4.4).

B-2.28.5 Idaho Solid Waste Management Regulations

These regulations, as developed by the Idaho Department of Health and Welfare in Title 1, Chapter 6, of the Solid Waste Management Regulations and Standards Manual, provide standards for the management of solid wastes to minimize the detrimental effects of disposal. These standards include requirements for the review of plans and approval of procedures and operational and postoperational standards for landfills, incinerators, and processing facilities and for transportation and storage of solid waste. (DOE 1995, Vol. 2, Part A, Section 7.2.4.5).

B-2.28.6 Idaho Rules and Regulations for Construction and Use of Injection Wells

Requirements for the construction, location, and use of injection wells within the State of Idaho are set forth in these regulations. The Department of Water Resources has been granted administrative authority over injection wells. Injection of radioactive or hazardous materials through an existing well or above a drinking water source is prohibited. Parameters for quality of fluids discharged and allowable uses of injection wells are included in these regulations as are classifications of well types and permitting requirements for injection wells. (DOE 1995, Vol. 2, Part A, Section 7.2.4.6).

B-2.29 Compliance Status at the Idaho National Engineering and Environmental Laboratory

The INEEL is committed to operating in compliance with all environmental laws, regulations, Executive Orders, DOE orders, and permits and compliance agreements with regulatory agencies. Regulatory agencies conduct inspections at the INEEL to ensure compliance with permits and other applicable legal requirements are being met.

In addition to oversight through external regulatory agencies, the DOE has a comprehensive program for conducting internal audits or inspections and self-assessments, including periodic reviews conducted by interdisciplinary teams of experts. The Department of Energy Idaho Operations Office (DOE-ID) has also prepared and issued an Environmental Compliance Planning Manual (DOE-ID-10166) that identifies the various requirements of federal and state agencies that DOE-ID considers to be pertinent to activities at the INEEL. This manual provides guidance and step-by- step methods needed to maintain compliance with applicable environmental requirements. (DOE 1995, Vol. 2, Part A, Section 7.2.5). A summary of the INEEL's current compliance with major environmental statutes and regulations is presented in the discussion that follows.

B-2.29.1 Comprehensive Environmental Response, Compensation, and Liability Act

In November 9, 1989, the INEEL was placed on the EPA's National Priority List, which is the nationwide list of private- and federal-owned sites identified by the EPA as requiring response actions under CERCLA. Following this listing, the DOE entered into negotiations with the State of Idaho and EPA Region 10, leading to execution of a Federal Facility Agreement and Consent Order on December 9, 1991. The purpose of the Federal Facility Agreement and Consent Order is to establish a procedural framework and schedule for developing, prioritizing, implementing, and monitoring appropriate response actions at the INEEL in accordance with the CERCLA, which will also be deemed to meet any corrective action requirements of the RCRA Section 3008(h) Consent Order and Compliance Agreement. The Action Plan portion of the Federal Facility Agreement and Consent Order sets forth a schedule for accomplishing the required activities. In conjunction with the EPA Region 10 and State of Idaho Project Managers, DOE-ID is engaged in various characterization, sampling, investigation, and interim action activities that are intended to provide the basis for selection of remedies at the operable units located on the INEEL. (DOE 1995, Vol. 2, Part A, Section 7.2.5.1).

B-2.29.2 Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III)

Authority for the programs under the Superfund Amendments and Reauthorization Act Title III reporting has been delegated by the EPA to each individual state. In accordance with Subtitle A (Emergency Response Planning and Release Notification), the State of Idaho has established an

Emergency Response Commission to handle the statewide work and the counties have established emergency planning committees to manage local activities. The INEEL is subject to and complies with the reporting requirements established in Title III. DOE-ID also prepares and submits reports required by Sections 311, 312, and 313 of the Superfund Amendments and Reauthorization Act. (DOE 1995, Vol. 2, Part A, Section 7.2.5.2).

B-2.29.3 National Environmental Policy Act

A comprehensive program to ensure compliance with the National Environmental Policy Act requirements is in place at the INEEL and is described in the DOE-ID Environmental Compliance Planning Manual (DOE/ID-10166). This program has evolved over the last several years, culminating recently in promulgation of DOE National Environmental Policy Act regulations (10 CFR Part 1021) and the issuance of numerous guidance memoranda by the DOE Office of NEPA Policy and Assistance (EH-42). (DOE 1995, Vol. 2, Part A, Section 7.2.5.3).

B-2.29.4 Safe Drinking Water Act

The Safe Drinking Water Act Underground Injection Control regulations require that deep injection wells be permitted or that permits be submitted to the state, and shallow wells be inventoried. The injection wells are used to dispose of storm water runoff. The DOE also inventoried shallow injection wells at the INEEL and submitted the information to the state as required. The Idaho Department of Environmental Quality conducts periodic sanitation surveys. A sanitation survey was conducted by the Idaho Department of Environmental Quality in December 1990. Additionally, both the State of Idaho and the City of Idaho Falls regularly monitor the INEEL's drinking water supply system. The most recent state audit was conducted in December 1990. (DOE 1995, Vol. 2, Part A, Section 7.2.5.4).

B-2.29.5 Clean Air Act

The INEEL has several facilities with air quality permits from the State of Idaho. These facilities are operated in compliance with permit conditions. Permit applications currently are pending with the State of Idaho for proposed new or modified emission sources. An inventory of all potential radioactive and criteria pollutant emission sources was completed and sent to the State of Idaho in April 1991. The inventory contains information necessary to issue the INEEL a Permit to Operate.

The Idaho Department of Health and Welfare, Division of Environmental Quality, and Air Quality Bureau conduct annual inspections of the INEEL facility to determine whether the operating portions of the facility are in compliance with the Rules and Regulations for the Control of Air Pollution in Idaho. Additionally, pursuant to 40 CFR Part 61.94 (H), the DOE submits on an annual basis a report documenting compliance with National Emission Standards for Hazardous Air Pollutants at the INEEL. (DOE 1995, Vol. 2, Part A, Section 7.2.5.5).

B-2.29.6 Clean Water Act

The INEEL does not discharge liquid effluents to surface waters of the United States. Sewage treatment plants are operated in compliance with applicable state regulations. The DOE has obtained a general permit for storm water discharges under the National Pollution Discharge Elimination System regulations, and has prepared storm water pollution prevention plans for industrial facilities at the INEEL and for construction activities. (DOE 1995, Vol. 2, Part A, Section 7.2.5.6). Closure activities associated with TFF that would modify drainage patterns or have the potential to disturb the ground surface would be required to be conducted in accordance with the Idaho Chemical Processing Plant (ICPP) storm water pollution prevention plan.

B-2.29.7 Resource Conservation and Recovery Act and State of Idaho Hazardous Waste Management Act

The State of Idaho was granted final authorization by the EPA to operate its hazardous waste program in lieu of the federal RCRA program (with the exception of the Hazardous and Solid Waste Amendments corrective action provisions) on April 9, 1990. Before this point, the EPA administered the entire RCRA program in Idaho. On June 5, 1992, the State of Idaho received final authorization for the Hazardous and Solid Waste Amendments corrective action provisions.

In October 1985, RCRA Part A and B permit applications were submitted by DOE-ID to EPA Region 10 for a number of hazardous waste units at the INEEL. In November 1985, the EPA requested additional information on hazardous waste land disposal units at the INEEL. It was determined that corrective action for these units would be the subject of a Consent Order and Compliance Agreement that was signed by the EPA, DOE-ID, and the U. S. Geological Survey in July 1987. In December 1991, the Federal Facility Agreement and Consent Order was signed. The Federal Facility Agreement and Consent Order superseded the Consent Order and Compliance Agreement that resulted in corrective action requirements at the INEEL being investigated under 40 CFR Part 120 (CERCLA).

After DOE-ID's submittal of an initial Part A and B permit application in October 1985, the State of Idaho and EPA Region 10 concluded the application was incomplete. On September 23, 1988, the EPA announced that hazardous waste management units involving radioactive waste mixed with hazardous waste in existence on or before July 3, 1986, were eligible for interim status if RCRA Part A permit applications identifying these units were submitted by March 23, 1989. On November 8, 1988, DOE-ID submitted a revised Part A and B permit application for RCRA units at the INEEL. The permit application addressed all hazardous and mixed waste management units potentially subject to RCRA, thus qualifying these units for interim status. Because of the large number of units involved, adequate time was not available for submittal of all of the Part B permit application by November 8, 1988. Thus, a schedule was negotiated for submitting the Part B permit applications on a phased basis. The State of Idaho issued a determination in March 1990 that the units listed in the DOE-ID November 1988 Part A permit application were eligible for interim status. On March 19, 1991, the State of Idaho approved interim status for all INEEL units listed in the September 1990 submittal of the INEEL Permit Application. (DOE 1995, Vol. 2, Part A, Section 7.2.5.8).

2.29.8 Resource Conservation and Recovery Act Subtitle D and State of Idaho Solid Waste Facilities Act

Disposal of nonmunicipal, nonhazardous solid waste is regulated by 40 CFR 257, "Criteria for Classification of Solid Waste Disposal." These regulations provides criteria for use under RCRA in determining which nonmunicipal solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. Generally, these regulations provide guidance for siting, design, and operation of a landfill facility. Municipal solid waste is regulated by 40 CFR 258, "Criteria For Municipal Solid Waste Landfills." Municipal solid waste is defined by 40 CFR 258.2.as:

> " a discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under § 257.2. A MSWLF unit also may receive other types of RCRA subtitle D wastes, such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste and industrial solid waste."

The Idaho Environmental Protection and Health Act (located at 39-101 through 39-130 Idaho Code) sets forth Idaho's policy for protection of the environment and creates the Department of Health and Welfare as an executive department of the state government. The director of the Department of Health and Welfare has powers and duties for the "administration of solid waste disposal site and design review in accordance with the provisions of Chapter 74, Title 39, Idaho Code;" and to provide for the "review and approval regarding the design of solid waste disposal facilities and ground water monitoring systems and approval of all applications for flexible standards as provided in 40 CFR 258, in accordance with the provisions of Chapter 74, Title 39, Idaho Code." This authority was contingent upon the EPA's approval of Chapter 74, Title 39 (The Idaho Solid Waste Facilities Act) pursuant to Idaho's implementation of 40 CFR 258 for municipal solid waste landfills [39-105 (3)(m)(iv) Idaho Code]. EPA approval occurred on September 21, 1993. As the INEEL does not generate or dispose of municipal waste, they are not regulated by the State of Idaho.

The requirements of 40 CFR 257 are applicable to Subtitle D landfills (nonhazardous, nonmunicipal waste landfills) on the INEEL. Under IDAPA 16.01.05.011 [40 CFR 257.9 (d)], a characteristic hazardous waste treated so that it no longer exhibits the hazardous characteristic shall be disposed in a Subtitle D landfill. In correspondence to J. Mitchell, LITCO, from B. R. Monson, Chief, Operating Permits Bureau, State of Idaho Permits and Enforcement, it is stated that "any landfill on the INEL that meets the chapter 257 standards for floodplains, endangered species, surface water, groundwater, disease, air, and safety may be identified to receive waste that no longer exhibits a hazardous characteristic"[B-1] (Monson 1996). A disposal site for low-level waste (LLW) or Class C grout that is delisted and treated to remove the hazardous characteristic would be required to meet this standard.

2.29.8.1 Notices of Violations/Noncompliance (NOV/NONs) and Associated Compliance Orders. NOV/NONs and associated compliance orders arise from EPA or state inspections at the INEEL for applicable environmental or other laws. Typically, several months after an inspection, the state/EPA issues an NON or NOV. DOE would then respond and eventually a Consent or Compliance Order is generated by the state or EPA (or other agency) covering the resolution. The following NON/NOVs have been received from the EPA and the State of Idaho, respectively, for INEEL RCRA hazardous waste management activities.

January 29, 1990 - NON received by DOE-ID. The resulting Consent Order was signed on April 3, 1992. The NON was based primarily on secondary containment issues for the ICPP TFF and hazardous waste storage issues including those at the Radioactive Waste Management Complex. Section 6.10 of the Consent Order provides schedules for either bringing the TFF into compliance with secondary containment requirements or closing the tanks. On March 17, 1994 the NON Consent Order was modified to incorporate terms of the district court's amended order in United States of America vs. Andrus dated December 22, 1993.

The State of Idaho, Department of Energy, and Department of the Navy entered into a Settlement Agreement on October 16, 1995 to resolve issues in the actions Public Service Co. of Colorado v. Batt, No. CV 91-0035-S-EJL (D. Id.) and United States v. Batt, No CV-91-0054-S-EJL (D. Id.). This agreement identified commitments and schedules associated with INEEL activities including, but not limited to, management of waste, transuranic waste, spent fuel, and HLW. Specific commitments impacting the TFF project include the commencement of calcination of sodium-bearing waste (SBW) by June 1, 2001 with completion by December 31, 2012.

June 5, 1991 - The first NOV was received by DOE-ID. The resulting Consent Order was signed on October 23, 1992. This NOV required DOE to cease use of the ICPP Percolation Ponds for disposal of hazardous waste and begin RCRA Closure . This NOV also addressed minor storage-related violations. The Consent Order provides a schedule for ceasing use of the ICPP Plant Percolation Ponds and beginning RCRA Closure . The Consent Order also sets requirements for coming into compliance on the storage-related violations.

The second NOV was received by DOE-ID in February 1993, and the resulting Consent Order was signed on May 16, 1994. This NOV alleged minor labeling, recordkeeping, and waste characterization violations. Except for a disagreement about proper procedures for handling CERCLA investigation derived waste, the minor violations were either addressed by on-the-spot corrective action or dismissed by the State of Idaho.

The third NOV was received by DOE-ID in October 1994. The resulting Consent Order was signed on October 6, 1995. This NOV alleged minor labeling, recordkeeping, inspection, and waste characterization violations. The NOV also alleged violations of RCRA groundwater monitoring requirements and improper disposal of hazardous wastes. Most of the concerns were corrected at the time of inspection or shortly thereafter.

The fourth NOV was received by DOE-ID in October 1995. The resulting Consent Order was signed by Argonne National Laboratory-West (ANL-W) on April 30, 1996. The Consent Order required corrective actions and penalty payments for activities at ANL-W only.

The fifth NOV was received by DOE-ID in March 1996. The majority of the violations were remedied before the completion of the inspections. The Consent Order was signed on January 16, 1997. The NOVs alleged labeling, recordkeeping, inspection, waste determinations, and waste management violations. The Consent Order identified corrective actions to resolve the violations and to improve hazardous waste management at the INEEL and established penalty payments for violations.

B-2.29.8 INEEL Federal Facility Compliance Act Status

The DOE has developed an inventory of the mixed waste subject to the Federal Facility Compliance Act. In coordination with the development of the Interim Mixed Waste Inventory Report and the Final Mixed Waste Inventory Report, the DOE developed a Site Treatment Plan to identify the selected treatment for DOE's mixed waste streams. The Final Site Treatment Plan, a controlled document, was published on October 31, 1995, and is updated at least annually. The Consent Order based on the Site Treatment Plan was signed by DOE-ID, EPA, and the State of Idaho on October 31 and November 1, 1995. (DOE 1995, Vol. 2, Part A, Section 7.2.5.9).

B-2.29.9 Transportation Requirements

All transport of hazardous and radioactive materials that takes place offsite (that is, on public roads) is in compliance with DOT and NRC requirements. (DOE 1995, Vol. 2, Part A, Section 7.2.5.10).

B-2.29.10 Water Quality and Wastewater Land Application

Separate from the Clean Water Act, the State of Idaho has a program that provides for the protection of all "waters of the State." Specifically, water quality standards established by the State of Idaho are met for current operations at the INEEL. (DOE 1995, Vol. 2, Part A, Section 7.2.5.11).

B-2.30 Tank Radioactive Waste Classification

The disposal or storage of radioactive waste is regulated by DOE and the NRC pursuant to the Atomic Energy Act and the Energy Reorganization Act. DOE's guidance for classifying waste is contained in DOE Order 5820.2A, "Radioactive Waste Management." The order classifies waste into HLW, LLW, transuranic waste, hazardous waste, and mixed waste. NRC guidance on waste classification is contained in 10 CFR 60 (Disposal of High-Level Radioactive Wastes in Geologic Repositories) and in 10 CFR 61 (Licensing Requirements for Land Disposal of Radioactive Waste). HLW is defined in 10 CFR 60 as (a) irradiated reactor fuel, (b) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (c) solids into which such liquid wastes have been converted. LLW is classified as A, B, C, and greater-than-Class C in 10 CFR 61.55. Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides whose potential hazard will persist long after such precautions such as institutional controls, waste form, and deep disposal have ceased to be effective. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective. [Section 6.2.1 of the Final Environmental Impact Statement for the Tank Waste Remediation System (DOE/EIS-0189)]. As of July 1, 1997, DOE LLW disposal is not regulated by the NRC; however, NRC rulings regarding waste treatment and waste feed limitations will affect classifying waste that is subject to HLW disposal requirements.

B-3. REFERENCES

1. Munson, B. R., 1996, Correspondence from Munson, Chief, Operating Permits Bureau, Permits and Enforcement, State of Idaho to J. Mitchell, Lockheed Idaho Technologies Company, July 23.

Appendix C

VE Session Heel Stabilization Scenario Development

CONTENTS

FIGURES

TABLES

C-1. HEEL STABILIZATION METHODS

A Value Engineering (VE) Session was held to develop and choose viable methods for heel stabilization. Experts in CPP Tank Farm Operations, Regulatory Issues, Radiological Controls, and Engineering assembled to use their experience, creative input, and problem-solving capabilities to decide the best solutions for this portion of Tank Farm Facility (TFF) Closure.

Various scenarios (called options in the VE Session.) were brainstormed regarding heel disposition. These scenarios were analyzed for practicality and eliminated if considered unreasonable. Of the initial scenarios, 10 were chosen for further discussion and evaluation. The VE team members considered aspects such as safety, cost, regulatory issues, stakeholder perceptions, and design as guidelines in selecting the three most viable scenarios for stabilizing the heel. The scenarios were then ranked with the aid of a "Decision Analysis Matrix." The three highest ranking scenarios were selected for further analysis and are described in this appendix.

The three scenarios are briefly described below with a more detailed description of each scenario following. Please refer to Reference 8-2 in Section 8.6 for further VE Session details.

The top three scenarios selected during the VE Session are briefly described below. Each scenario's perceived advantages and disadvantages are discussed following the overview.

C-1.1 Clean Tank and Grout Any Remaining Heel—Scenario A

This scenario received the highest overall score of the 10 scenarios analyzed (see Option G in the VE Session report.). The process does not attempt to remove all waste from the tank but rather makes an effort to remove most of the radioactive and hazardous waste from the tank dome, walls, cooling coils, and floor.

C-1.1.1 Heel Stabilization Sequence

The starting conditions that must be satisfied before heel stabilization can occur:

1. Tank liquid has been removed, to the maximum extent possible, using existing waste transfer equipment (steam jets or airlifts). This leaves an approximate heel depth of 4 to 12 inches (5,000 to 15,000 gallons). This is the point of cease use.

2. Tank Isolation has occurred to the maximum extent possible. RCRA closure has begun.

3. Temporary VOG system connected and operating.

In sequence, the steps required to accomplish Scenario A are:

1. Characterize remaining heel using new sampling equipment (provides a closure baseline).

2. Clean tank interior by washing tank dome, walls, cooling coils, and floor.

3. Remove as much tank liquid as possible using existing equipment.

NOTE: This step is intended to minimize personnel exposure but could be deleted.

4. Complete tank isolation.

NOTE: This step is only required if some tank lines were not previously isolated.

5. Agitate heel and washdown liquid with mixing pump, remove heel with submersible pump (< 1 inch heel remains).

6. Flush heel with water or aluminum nitrate then agitate and remove heel with submersible pump (< 1 inch heel remains) perform flush twice.

7. Check remaining heel pH, if heel pH is acceptable (0.5 - 2.0), continue to next step.

   - if heel is too acidic, continue heel flushing and removal process until proper pH has been achieved.

8. Characterize remaining heel.

9. Deposit liquid grout in tank, starting at point furthest from submersible pump displacing heel towards submersible pump (grout slump is maintained to allow heel displacement without grout and heel mixing).

10. Remove displaced heel continuously with submersible pump as liquid grout is being deposited in the tank bottom.

11. Raise submersible pump to allow grout to flow underneath while still pumping or abandon pump in place.

12. Continue adding wet grout until a 12-inch thick grout layer is on tank floor and allow grout to set up.

13. Absorb any remaining liquid using dry grout

14. Place additional liquid grout to cover solidified heel and cooling coils by 4 inches.

Refer to Figure C-1 showing the Scenario A flow chart and Figure C-2 of the displacement method.

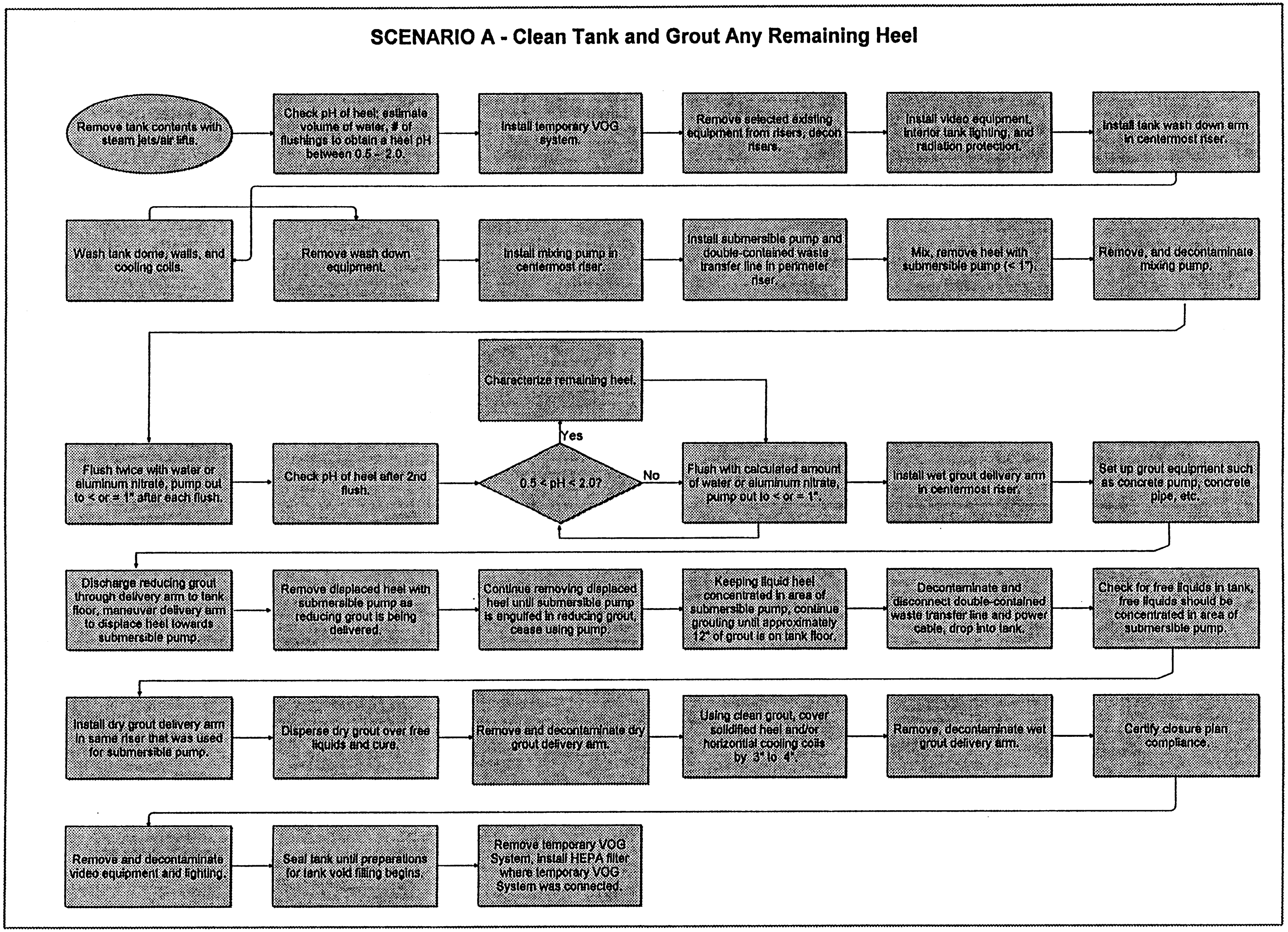
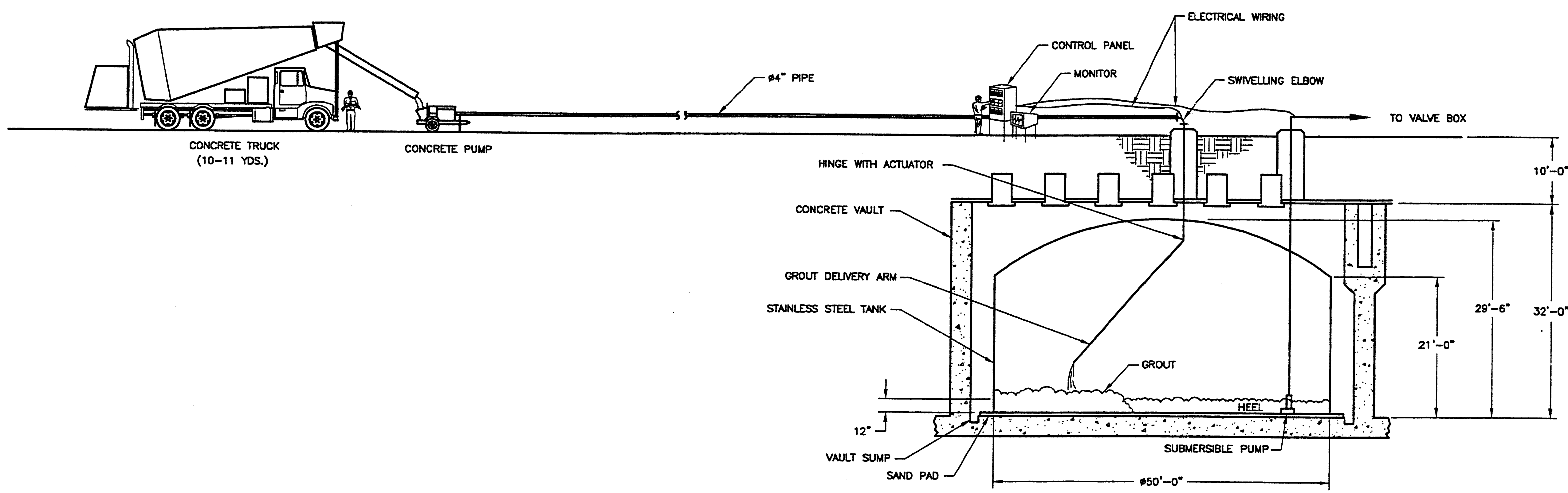


Figure C-1. Scenario A - Clean Tank and Grout Any Remaining Heel.

SCENARIO A
HEEL DISPLACEMENT
FIGURE C-2



PARTS LIST

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY

HEEL DISPLACEMENT

SIZE D CAGE CODE 01MF3 530 DWG–

SCALE: NONE SHEET 1 OF 1

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C-1.2 Heel Displacement With Grout Using Additional Waste Transfer Equipment—Scenario B

This scenario received the second highest overall score of the 10 scenarios analyzed (see Option B in the VE session report.).

In sequence, the steps to accomplish this scenario are.

1. Remove as much pH-adjusted tank liquid as possible with existing equipment (steam jets or air lifts).
2. Characterize the remaining heel.
3. Install submersible pump in tank riser.
4. Deposit wet grout in tank, starting at point furthest from submersible pump (slump of grout is maintained to effect heel displacement without grout and heel mixing).
5. Remove displaced heel continuously with submersible pump as grout is being deposited in tank bottom.
6. Raise submersible pump to allow grout to flow underneath while still pumping or abandon pump in place.
7. Absorb any remaining liquids with dry grout.
8. Place additional wet grout to cover solidified heel and cooling coils by four inches.

Refer to Figure C-3 showing the Scenario B flow chart and Figure C-4 of the displacement method.

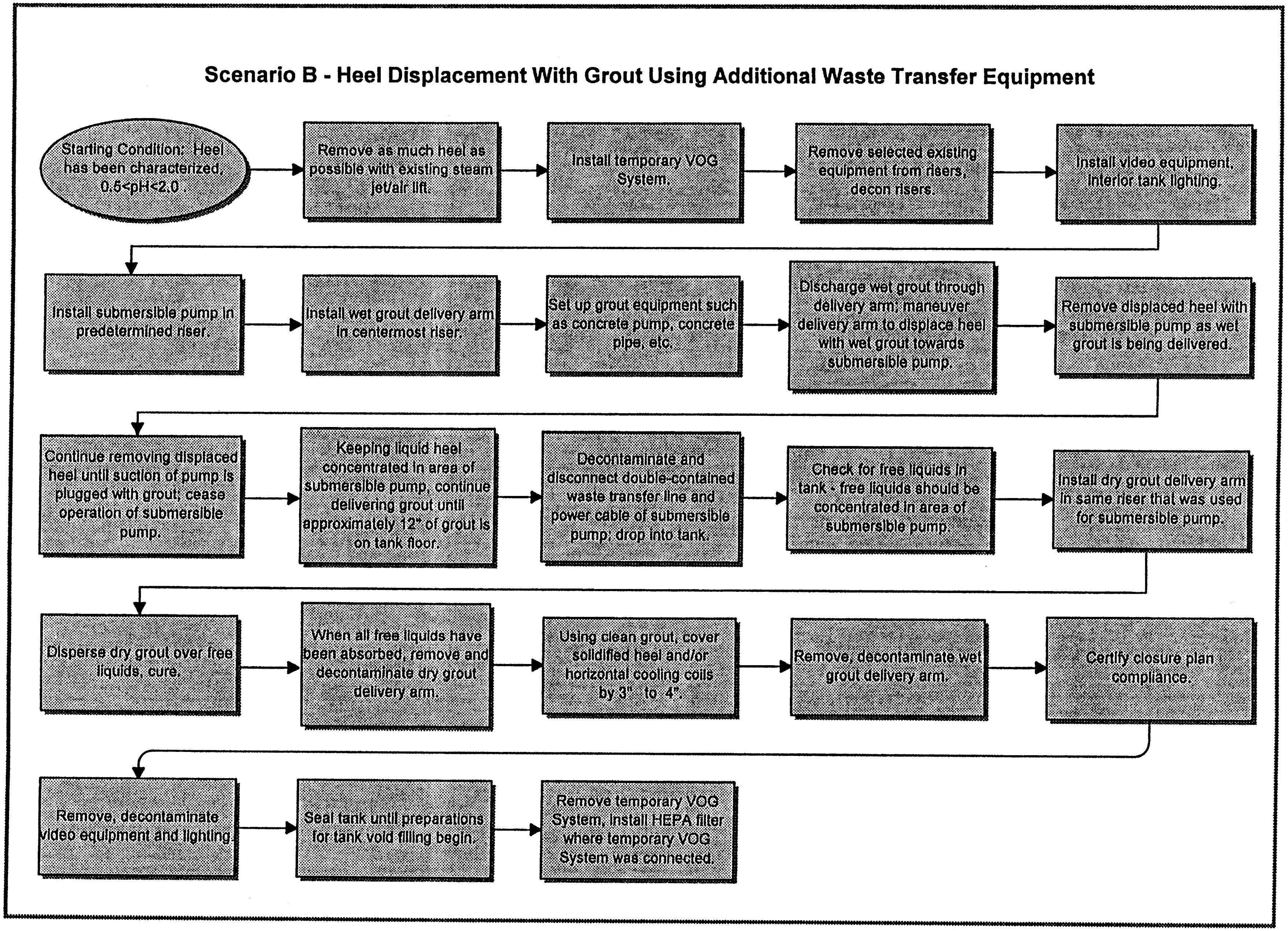
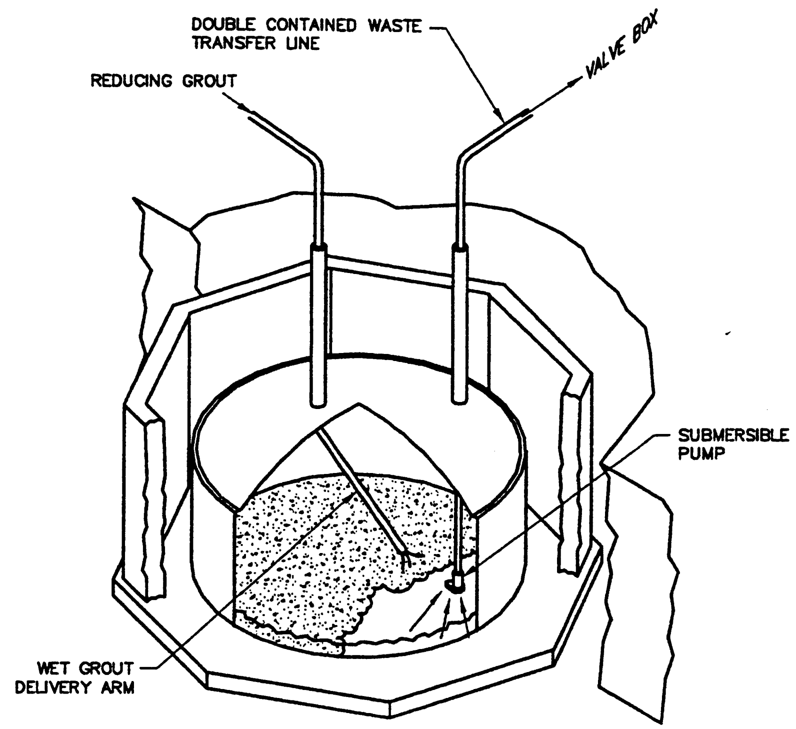
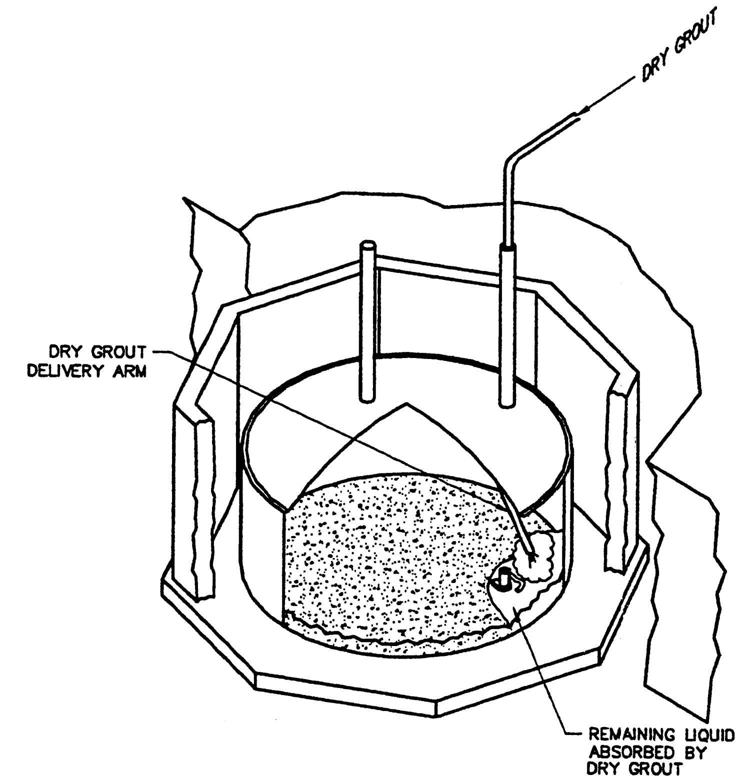


Figure C-3. Scenario B – Heel displacement with Grout using additional waste transfer equipment.

SCENARIO B
HEEL DISPLACEMENT WITH GROUT USING ADDITIONAL WASTE TRANSFER EQUIPMENT
FIGURE C-4



1. HEEL DISPLACEMENT & REMOVAL



2. ABSORPTION OF REMAINING HEEL WITH DRY GROUT

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
SCENARIO B
HEEL DISPLACEMENT WITH GROUT
USING ADDITIONAL WASTE TRANSFER EQUIPMENT

DRAWN: GREG HOUSLEY

SIZE D CAGE CODE 01MF3 530 DWG–

SCALE: NONE SHEET 1 OF 1

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C-1.3 Heel Displacement With Grout Using Existing Equipment—Scenario C

This scenario received the third highest overall score of the 10 scenarios analyzed (see Option A in the VE Session report.).

In sequence, the steps to accomplish this scenario are:

1. Remove as much pH-adjusted tank liquid as possible with existing equipment (steam jets or air lifts).

2. Characterize the remaining heel.

3. Deposit wet grout in tank, starting at point furthest from steam jet (slump of grout is maintained to effect heel displacement without grout and heel mixing).

4. Jet out displaced heel continuously as the grout is being deposited in the tank bottom.

5. Continue jetting process until grout flows into suction of jet and prevents further removal of heel.

6. Remove steam jet or leave in place.

7. Absorb any remaining liquids with dry grout.

8. Place additional wet grout to cover solidified heel and cooling coils by 4 inches.

Refer to Figure C-5 showing the Scenario C flow chart and Figure C-6 of the displacement method.

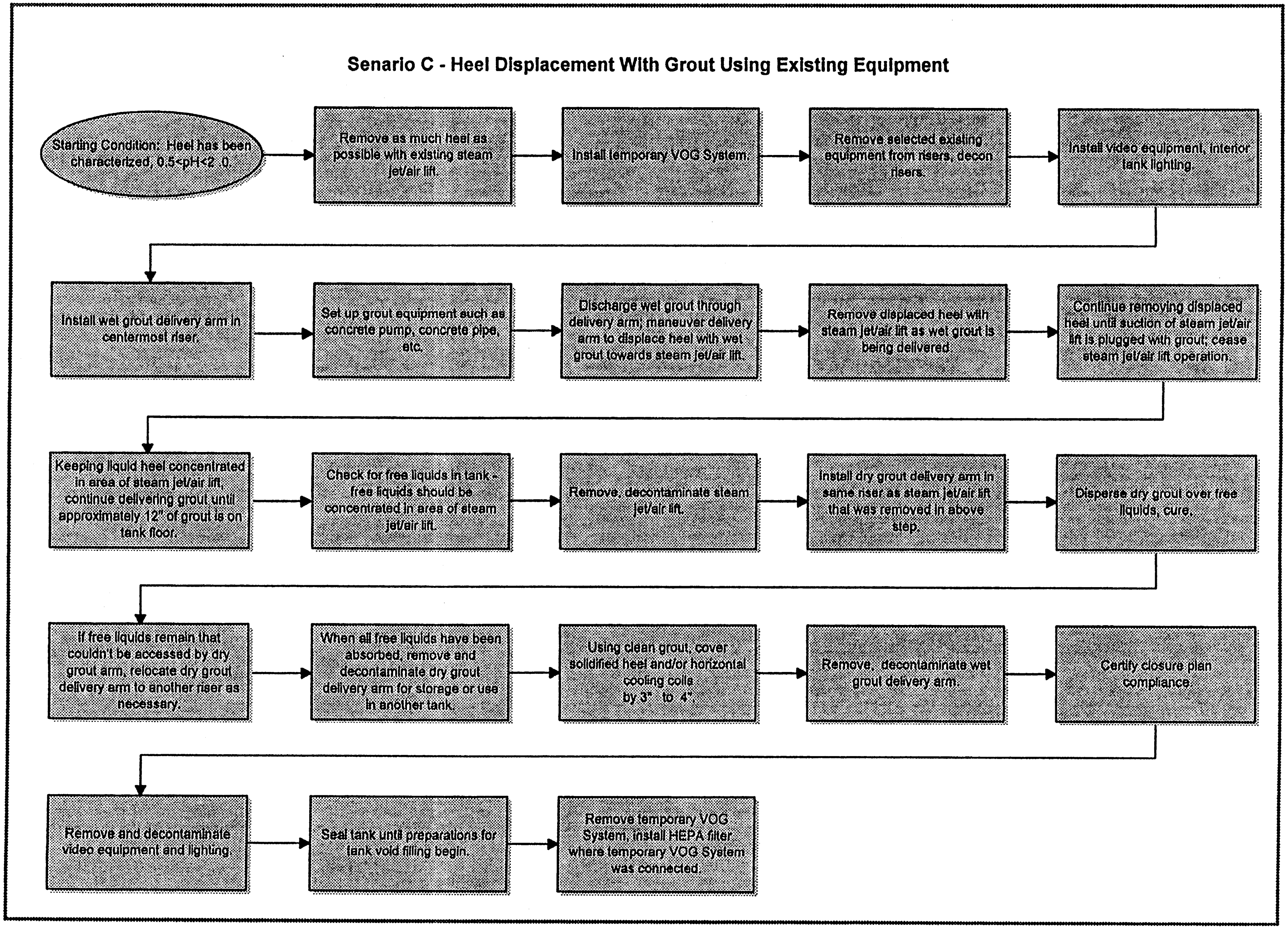
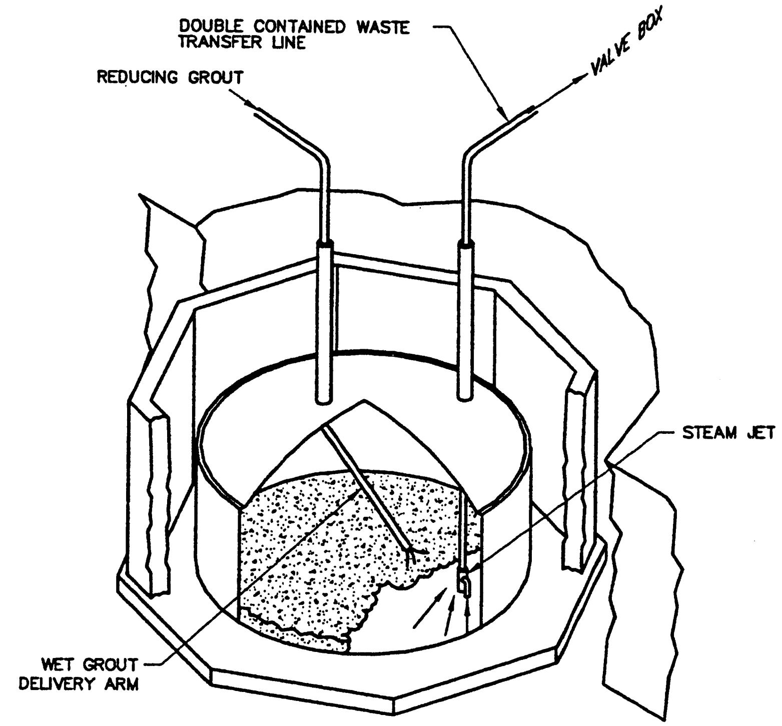
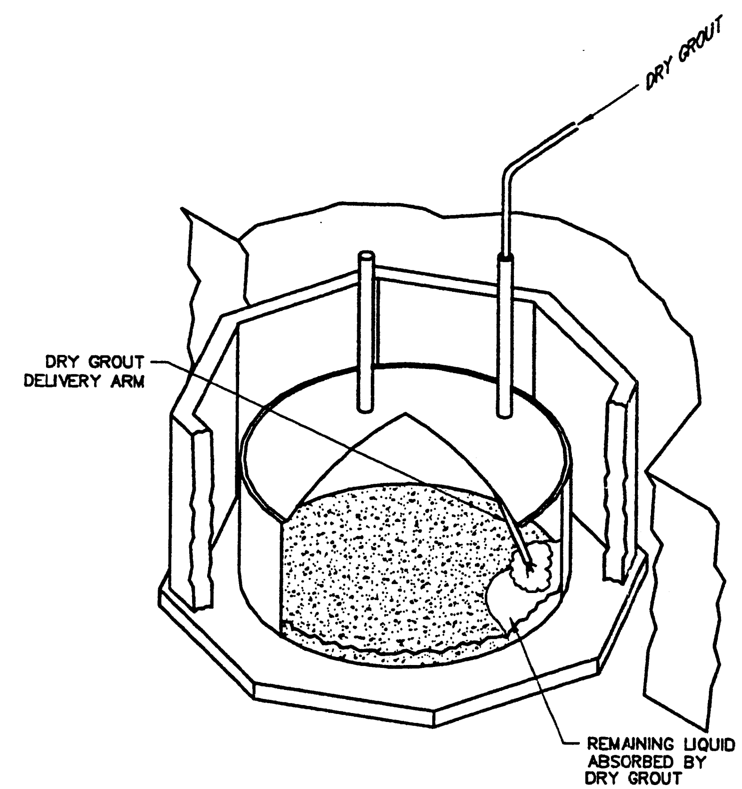


Figure C-5. Scenario C – Heel Displacement with Grout using Existing Equipment.

SCENARIO C
HEEL DISPLACEMENT WITH GROUT USING EXISTING EQUIPMENT
FIGURE C-6



1. HEEL DISPLACEMENT & REMOVAL



2. ABSORPTION OF REMAINING HEEL WITH DRY GROUT

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PARTS LIST

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SURFACE ROUGHNESS 125
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ±.1
DECIMALS: .XX = ±.03
.XXX = ±.010
FRACTIONS ±1/8
ANGULAR ±2°
DO NOT SCALE DRAWING

DASH NO. | NEXT QTY REQD | FINAL QTY REQD | NEXT ASSY
APPLICATION

SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN: GREG HOUSLEY
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
SCENARIO C
HEEL DISPLACEMENT WITH GROUT
USING EXISTING EQUIPMENT

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA | TYPE | CL | ORIG 530 | DWG- | REV
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C-2. VE SCENARIO ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages of each scenario are discussed below.

C-2.1 Scenario A

The principal advantage of this scenario is that the tank interior is cleaner because of washing down the tank dome, walls, cooling coils, and floor. Mixing the heel would suspend solids that are subsequently removed with a submersible pump, resulting in less radioactive and hazardous waste left in the tank. When compared to the other two scenarios, this scenario was considered by the VE session team to be the scenario most acceptable to stakeholders since less waste would be left in the tank.

The disadvantages, as compared to the other two scenarios, are higher costs and potentially higher radiation exposure when connecting, operating, and disconnecting the submersible and heel mixing pumps. More equipment will be required to carry out this task which increases design, fabrication, and purchase costs. Operational costs to install, operate, remove, and decontaminate equipment will also be higher than the other two scenarios. Personnel exposure to radiation may also be higher due to increased handling of potentially contaminated equipment.

C-2.2 Scenario B

The principal advantage of this scenario, as compared to Scenario C, is that more liquid heel will be removed by the submersible pump as the heel is displaced by the grout. Like Scenario A, remaining heel liquid will be concentrated near the submersible pump. Absorbing the remaining heel liquid with dry grout will require less effort and expense because the heel will be contained in a small area near the submersible pump.

The potential for radiation exposure will be lower than Scenario A since less equipment will be installed, removed, and decontaminated in the tanks. Relative cost as compared to Scenario A will be less, since a washdown arm and mixing pump will not be required.

The main disadvantage, as compared to Scenario C, is increased radiation exposure risk when connecting, operating, and disconnecting the submersible pump. Since tank wash down and heel agitation are not required for this scenario, a greater amount of mixed waste will be left behind when compared to Scenario A.

C-2.3 Scenario C

The principal advantage of this scenario is that existing waste transfer equipment (steam jet or air lifts) will be used to remove the displaced heel. Existing waste transfer equipment use reduces the potential radiation exposure risk because a submersible pump and discharge piping will not be installed or removed from the tanks.

The main disadvantages using steam jets or air lifts for removing the displaced heel, is that more of the liquid heel will be left behind due to limitations of the steam jets and air lifts. A relatively larger quantity of dry grout will be necessary to absorb the remaining liquid heel. The resulting waste form may not be as stable as the waste form that would result from a lesser amount of liquid heel that has been sprinkled with dry grout.

C-3. DETAILED DESCRIPTION OF SELECTED VE SCENARIOS.

The previous sections presented a brief overview of the selected heel stabilization scenarios to familiarize the reader with the basic concepts and methods presented during the VE Session. The work scope of these scenarios is described in further detail in the following subsections.

C-3.1 Clean Tank and Grout Any Remaining Heel—Scenario A

The overview described this scenario's basic heel stabilization steps as:

1. Wash down the tank interior.

2. Flush the remaining heel to adjust the pH.

3. Remove as much of the heel as possible with a submersible pump.

4. Place wet grout in the tank bottom.

5. Place dry grout on any remaining liquid heel.

6. Place enough wet grout to cover the solidified heel and horizontal portion of the cooling coils by 3 to 4 inches.

As stated earlier, this scenario does not attempt to remove all radioactive and hazardous material from the tank but rather makes an effort to remove most of the mixed waste from the walls and floor. Fixed or not readily accessible residues would remain in the tank.

C-3.1.1 Tank Preparation

Before tank washdown and heel displacement can occur, the tank must be prepared to accept equipment related to these activities. The following steps are in the sequence that tank preparation will take place, although some steps may take place concurrently with other preparatory steps.

C-3.1.2 Removal of Tank Liquids

Liquid wastes inside the tank will be removed to the lowest possible level with existing steam jets or airlifts before the tank risers are opened for equipment removal or installation. Depending on the tank, a heel volume of approximately 5,000 to 15,000 gallons remain after jetting has taken place.

C-3.1.3 Installation of Temporary VOG System

Before tank risers are opened, a temporary VOG system will be installed to maintain a negative pressure (0.5 in. w.c.) inside the tank. A slight negative pressure will ensure that air flows into the tank when risers are opened.

A temporary VOG system will tie into the piping of the existing TFF VOG system. The tie-in will be made so tanks continue to operate on the existing VOG system. The tank where heel solidification activities occur will be connected to the temporary VOG system.

C-3.1.4 Heel Characterization

Current waste sampling is conducted using existing steam jets or airlifts. Steam dilutes the sample by approximately 10% and can affect the sample by introducing heat. A heel sample will be taken using a new sampling system to establish a baseline for current tank heel composition. This baseline will be used to determine how effectively flushing reduces the activities and concentrations of radioactive and hazardous heel constituents. Measurement of the pH will provide a basis for estimating the volume of liquid or chemical addition necessary to flush the heel in order to obtain a heel pH of 0.5 to 2.0.

C-3.1.5 Removal of Existing Equipment from Tank Risers

To install video cameras and lighting, tank washdown equipment, mixing pump(s), submersible pump(s), and grout delivery arms, it will be necessary to remove existing in-tank equipment. Equipment to be removed includes steam jets and air lifts, radiofrequency probes, and corrosion coupons. Equipment for heel stabilization activities will be installed after the existing equipment has been removed.

A crane will be required to lift concrete shielding blocks and existing in-tank equipment. The crane will presumably be positioned in different areas of Zone C (see Figure 6-1). However, further analysis will be required to establish weights of the crane, in-tank equipment, and heel solidification equipment to ensure that total weight combinations do not cause overloading in the various areas of the TFF.

C-3.1.6 Installation of Video Equipment and Tank Interior Lighting

Video equipment and tank interior lighting will be the first equipment installed within the tank risers. Remote cameras and tank interior lighting will be located in a predetermined riser as a tool to ensure that equipment is maneuvered and positioned properly within the tank. Video equipment could also be used to document the conditions inside the tanks before and after tank wash down and heel grouting.

Several monitors will be located in the TFF. One video monitor will be in the instrumentation trailer (located outside the fenced area) and another near a control panel at the tank. Visitors could observe tank closure activities at the video monitor in the control trailer. Operations personnel located at the tank will use a local video monitor to operate equipment inside the tank. Appropriate conduit and instrumentation cables will be routed as necessary to connect video equipment and controls to the instrumentation trailer and local control panel.

C-3.1.7 Radiation Shielding Installation

As required, temporary radiation shielding will be placed around equipment that has been installed in the tank risers such as the video equipment and tank lighting. Lead blankets or concrete blocks could be used to provide temporary shielding.

Further study will be necessary to determine the actual materials and thicknesses required for effective shielding.

C-3.1.8 Heel Stabilization

Heel stabilization includes tank washing, heel mixing and removal, and a final heel characterization.

C-3.1.9 Tank Washdown

The next step is to install tank washdown equipment. Previous video inspections indicate that residues exist on the tank walls and cooling coils. The intention of washing the tank internally is to remove or loosen up most residue buildup from the walls, flooring, and piping that have accumulated over the years. Removing a large portion of this residue will reduce overall mixed waste concentrations in the tank.

A previous study[C-1] ICF Kaiser Engineers, "Existing Tank Flushing Special Study," evaluated spray distances, nozzles, and the time and amount of solution required for washing the tank dome, wall, and floor. Three wash-down scenarios using different cleaning solutions were also evaluated in the study. The study recommended a solid stream nozzle for initial wash down and removal of solids. A fan nozzle was recommended for final rinsing of the tank interior.

Following the study's recommendation, a solid stream nozzle will be used for initial wash down and a fan nozzle will be used for final rinsing. Further study will be required to determine the appropriate cleaning solution used in washing the tank interior.

C-3.1.10 Tank Washdown Equipment

The tank wash down system will use two major pieces of equipment: trailer mounted washdown skid and washdown arm. The wash down skid will consist of a decontamination tank, a supply pump, and associated piping and instrumentation. The wash down arm will be inserted within the tank and designed to direct the spray from the top to the bottom of the tank. The wash down arm will rotate 360 degrees so that the entire circumference of the tank can be accessed for washing. Flexible hose will interconnect the washdown skid to the washdown arm.

Tank washdown equipment will be designed for use on all 11 tanks. Adapters for the wash down arm will be necessary to permit use on either 12-inch or 18-inch risers. Freeze protection provisions (that is, insulation and heat trace) will be necessary for aboveground piping located outside the heated enclosure. A main supply line that is insulated and heat traced may be the most effective means for delivering wash down fluids to the area. The main supply line would have taps strategically located to allow hookup of temporary hoses to washdown equipment at each tank.

C-3.1.11 Installation of Tank Washdown Equipment

Because the location of tank risers is different for each tank, placement of tank washdown equipment will depend upon riser location. If the wash down arm is placed in a single location that allows effective wash down coverage of the entire tank, relocation efforts and expenditures within the same tank will be minimized.

Since the concept of this scenario is to wash most, but not all, residue from the dome, walls, cooling coils, and floor, the wash down arm will initially be placed in the centermost riser. However, if more washdown is desired for particular areas of the tank, the washdown arm could be relocated to another riser.

C-3.1.12 Washdown Procedure

The dome, walls, cooling coils, and tank floor will be washed down once with approximately 12,000 - 15,000 gallons of water or other cleaning solution.

Washdown will begin with the cooling coils and tank floor to loosen any sediments attached to the piping, crevices, floor bottom, etc. After the floor and coils have been washed, washing will then move to the dome area. Upon completion of the dome, the walls will be washed from top to bottom, finishing at the tank floor.

When washdown is complete, the depth of washdown fluid and residues remaining in the tank bottom will be approximately 16 to 24 inches.

C-3.1.13 Removal of Tank Washdown Equipment

After the tank interior has been washed, the washdown arm will be removed from the centermost riser and reinstalled in another tank. The washdown arm could also be installed in another riser within the same tank for further cleaning.

To minimize contamination of the wash down arm, the outside of the arm could be covered with a removable plastic sleeve. As the arm is slowly withdrawn from the riser, the plastic sleeve would be decontaminated and peeled from the arm. A new plastic sleeve would replace the sleeve that was peeled from the arm in preparation for transport and use in another riser.

C-3.1.14 Heel Mixing and Heel Removal

Once the interior of the tank has been washed, the liquid heel (16 to 24 inches) will be mixed in an effort to suspend solids residing on the tank floor. A submersible pump will then remove the mixed heel.

The mixing pump will mix and recirculate the liquid heel within the tank. As mixing progresses, solids near the suction of the pump will be removed and displaced towards the perimeter of the tank. This may cause an accumulation of solids in the area where the tank walls and tank floor join and around the cooling coil supports.

If it is necessary to remove solids that have accumulated in regions of the tank during heel mixing, the tank wash down arm could be reinstalled in a tank riser and used intermittently to direct a focused stream of water into areas where solids have accumulated. The solids could be washed toward the center of the tank for further agitation or directed toward the submersible pump for removal from the tank.

As the heel is mixed and solids are suspended, the submersible pump will be energized to transfer the mixed heel out of the tank to a receiving tank. As the level in the tank is lowered, the mixing pump will begin to cavitate when the Net Positive Suction Head (NPSH) becomes inadequate. At this point, the mixing pump will be deenergized and the submersible pump will continue to remove the remaining heel until the pump loses suction. Approximately ½ – 1 inches of heel will be left in the bottom of the tank.

The mixing pump assembly will be removed and decontaminated when no longer required. The mixing pump will either be stored in a temporary shelter or relocated to the next tank scheduled for heel stabilization.

C-3.1.15 Mixing Pump Description and Installation

The mixer pump could be a one-stage vertical turbine pump that draws in the liquid heel through the foot of the pump and discharges the heel horizontally through two nozzles that are opposed. The driver for the pump would be an electric motor mounted aboveground at the tank riser. The electric motor would be stationary while a turntable assembly slowly rotates the pump inside the tank. The mixer pump would be suspended with a column of pipe. The pipe column would house the drive shaft and contain bearings to support the drive shaft within. The drive shaft would be sealed to prevent upward migration of liquid heel through the pipe column to the surface.

Initially, a single mixing pump will be installed in the centermost riser of each tank. Since distances from the tank riser flanges to the tank floor bottom may vary from tank to tank, adjustable supports to suspend the pump will be fabricated that attach to the concrete shield currently in place at the tank risers. A second mixing pump could be installed in another riser if additional mixing is determined beneficial to suspend and remove more solids. Interference or clearance problems between the mixing pump and cooling coils on the tank floor bottom may occur. Interference with the cooling coils would prevent lowering the mixing pump assembly to within several inches of the tank floor. However, even if the mixing pump is suspended above the cooling coils, agitation can still take place within the tank heel if the liquid level is above the NPSH.

Radiation shielding will be installed at the surface of the tank riser to reduce radiation fields. Further work will be done in the future to determine the size and type of material necessary for adequate shielding.

C-3.1.16 Submersible Pump Description and Installation

Low cost submersible pumps capable of delivering approximately 50 gpm at 50 feet of head will be lowered through a tank riser and rest on the tank floor. The discharge line from the submersible pumps will be a double-contained flexible hose that is routed through the tank riser to the tank's associated valve box. The hose will temporarily tie into the existing waste transfer system at the valve box. The pumps will be abandoned in place upon completion of heel stabilization.

Radiation shielding will be installed at the riser where the flexible hose exits the tank. Radiation shielding such as earthen material will also be placed over the flexible hose connected from the riser to the valve box. Further investigation will be required to determine material types and thickness to control radiation exposures.

An additional pump could be lowered through the same riser and situated adjacent to the original pump if it was advantageous to remove the heel at a faster rate. If a different location in the tank is preferred, a pump could be placed in another riser.

C-3.1.17 Heel Characterization and pH Sampling

Before solidifying the heel with grout, the level of acidity in the heel must be checked to ensure that the pH is in the range of 0.5 – 2.0, to ensure proper setting and curing of the grout and the mixed waste amounts must be estimated to establish the waste amount left in each tank.

When removing the heel with the submersible pumps, a sample will be taken to check the pH of the heel. If the pH is in the range of 0.5 – 2.0, the heel will be characterized for radioactive and hazardous constituents, and then recorded for future reference. Otherwise, if the pH is less than 0.5, the heel will be flushed with a predetermined amount of water or aluminum nitrate [$Al(NO_3)_3$] and removed with the submersible pump. A sample will be taken to confirm that the heel pH is correct.

If the pH is in the range of 0.5 – 2.0, the heel will be characterized and the tank will be readied for the next phase of the heel stabilization process. Otherwise, the heel will be flushed until the proper pH is achieved and subsequently characterized before readying the tank for the next phase of heel stabilization.

Table C-1 shows the approximate heel pH through the tank wash down, heel removal, and flushing phases of Scenario A. Included in the table is the starting condition and the amounts of liquids that will be added to the tank to achieve the proper pH.

C-3.1.18 Tank Heel Displacement

A heel will remain in the tank that is approximately 1/2 to 1 inches deep with a pH between 0.5 and 2.0. Wet grout will be transported through a 2 to 4-inch pipeline to the delivery arm located in the tank's centermost riser. The maneuverable delivery arm will place grout to displace the remaining heel toward the submersible pump.

The submersible pump will remove the displaced heel until the suction is plugged with grout. Any free heel liquids will be localized near the submersible pump. The low-cost submersible pump will be abandoned in place. The power cable and flexible hose will be disconnected and dropped into the tank.

Any free liquids remaining on top of the solidified heel will be absorbed with dry grout. A maneuverable dry grout delivery arm will be inserted into the same riser where the submersible pump was installed. With the aid of the remote camera, the delivery arm will be maneuvered to disperse dry grout on the remaining free liquids. After the dry grout has been placed, the delivery arm will be removed and decontaminated.

As a final step, a layer of grout 3 to 4 inches thick will be poured over the solidified heel to absorb any remaining dry grout that was placed in the previous step. Wet grout will be transported through the pipeline to the grout delivery arm located in the centermost riser. If the horizontal portion of the cooling coils protrude through the solidified heel, additional grout will be added to cover the coils by 3 to 4 inches.

The wet and dry grout will be formulated to set up and cure with a compressive strength of at least 500 psi. A layer of grout approximately 12 inches thick in the tank will occupy a volume of approximately 72 yd^3. The total volume of grout required to solidify the heel and cover the cooling coils will be about 100 yd^3. The actual amount will vary depending on the cooling coil height.

C-3.1.19 Equipment Description

Several pieces of equipment will be necessary to accomplish heel displacement and pouring a cover. Examples of equipment include a concrete pump with hopper, concrete pipeline with quick-disconnect couplings, mechanized grout delivery arms with control systems and air compressor, and miscellaneous concrete cleaning accessories.

Detailed descriptions follow for the major pieces of equipment required. Refer to Figure C-2 for a sketch of the grout delivery equipment and relative placement.

Concrete Pump with Hopper. A trailer-mounted concrete pump will move the grout through the pipeline to the grout delivery arm. A concrete truck will unload grout into the funnel-shaped hopper of the concrete pump.

A typical "Ready-Mix" type concrete truck has a capacity of about 10 yd^3. Based on a total grout requirement between 140 and 150 yd^3 for heel displacement and covering, 14 or 15 truckloads of grout will be necessary to stabilize a tank heel.

Table C-1. Flushing calculations for the most acidic tank (WM-188).[C-1]

Initial Heel Volume = 15,000 gal | Final Heel Volume = 1,200 gal

Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter | Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

$pH = -\log_{10}(\text{moles } H^+/\text{liter})$

$(\text{moles } H^+/\text{liter})_s = (\text{moles } H^+/\text{liter})_{s-1} \times (\text{heel volume})_s / [(\text{heel volume})_s + (\text{liquid added})_s]$ where s = current step, $s-1$ = previous step

Flush Volume = 13,500 gal/flush

Step #	Action	Heel Volume (gal)	Liquid Added (gal)	Liquid Removed (gal)	Total Tank Liquids (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
1	Starting Conditions	15,000			15,000	2.6500	-0.42
2	Tank Wash Down	15,000	12,000		27,000	1.4722	-0.17
3	Remove Liquid With Submersible Pump	1,200		25,800	1,200	1.4722	-0.17
4	1st Flush of Heel	1,200	13,500		14,700	0.1202	0.92
5	Remove Liquid With Submersible Pump	1,200		13,500	1,200	0.1202	0.92
6	2nd Flush of Heel	1,200	13,500		14,700	0.0098	**2.01**
7	Remove Liquid With Submersible Pump	1,200		13,500	1,200		
			39,000	52,800			

Note: Washing the tank with 12,000 gallons of liquid followed by two 13,500-gallon flushes adjusts the pH from -0.42 to the target pH of 2.01. The volume of liquid that would be added is 39,000 gallons..

To accomplish heel displacement in 1 day, approximately seven truckloads of grout will be required. Based on conversations with personnel from concrete batch plants, the average time expected to unload a truck will be about 15 minutes. However, unloading time will depend on the rate the grout can be distributed in the tank. Maneuvering the grout delivery arm for correct grout placement may slow down the unloading process.

To conservatively size the concrete pump, an unloading time of 10 minutes will be assumed for the concrete truck. Therefore, the concrete pump will need to have an output capacity of 60 yd^3 per hour.

Schwing America Inc. manufactures a concrete pump (Model WP750-18X) that delivers up to 70 yd^3 per hour. The stroke length of the pump can also be shortened to decrease the flow rate to as low as approximately 10 yd^3 per hour. The ability to vary the flow rate by a simple adjustment adds to the versatility of this pump by allowing the operator to change flow rates to meet different conditions. If the flow rate is too fast during placement of the grout, the rate can be easily lowered.

Wet Grout Delivery Arm. The wet grout delivery arm will allow grout placement throughout the tank. It would be placed in the centermost riser in order to allow access to most areas of the tank. The arm will rotate 360 degrees inside the tank with a maximum horizontal reach of approximately 20 feet. The delivery arm will seal to the flange of the riser to reduce radiation fields.

A chain-driven gear could rotate the arm while a motorized electric actuator located at the hinge point would provide the required up-down motion. Grout from the pipeline would enter the delivery arm where a transition will be made to a disposable rubber hose supported by the delivery arm. To minimize decontamination and cleaning efforts, the rubber hose will be cut loose and dropped to the tank bottom when grouting is complete.

If the delivery arm impacts the tank structure with sufficient force, it could tear or gouge the side or bottom, thereby affecting the integrity of the tank for future containment. Therefore, the delivery arm must be designed so that if a mechanical or control failure occurs, the end of the delivery arm will not strike the side of the tank or tank bottom.

The delivery arm will be supported with the existing concrete shield at the tank riser. A framework attached to the grout delivery arm will bolt on to the concrete riser shield. The flange of the grout delivery arm will attach to the flange of the tank riser.

Dry Grout Delivery Arm. The dry grout delivery arm will allow grout placement of the dry grout locally within a 10 ft radius. It would be placed in the same riser that was occupied by the submersible pump(s). The arm will rotate 360° inside the tank with a maximum horizontal reach of approximately 10 ft. The delivery arm will seal to the flange of the riser to reduce radiation fields.

A chain-driven gear could rotate the arm while a motorized electric actuator located at the hinge point would provide the required motion for horizontal placement. Dry grout from a pipeline would enter the delivery arm and be either augured or blown where necessary to absorb any remaining heel liquids.

The dry grout delivery arm will be designed so that if a mechanical or control failure occurs, the end of the delivery arm will not strike the side of the tank or tank bottom. If the delivery arm impacts the tank structure with sufficient force, it could tear or gouge the side or bottom, thereby affecting the integrity of the tank for future containment.

The delivery arm will be supported with the existing concrete shield at the tank riser. A framework attached to the grout delivery arm will bolt on to the concrete riser shield. The flange of the dry grout delivery arm will attach to the flange of the tank riser.

Air Compressor and Cleanout Accessories. An air compressor will be necessary to clear the pipeline of grout when pumping has ceased. A sponge cleanout ball (or "pig") will be placed in the pipeline through a special attachment located just downstream of the grout pump. Air will be introduced into the attachment forcing the sponge ball and grout downstream towards the delivery arm. The sponge ball will exit the delivery arm into the tank when the pipeline has been purged of grout.

The grout pump and hopper will be flushed and rinsed with water. The flush/rinse water could be captured in a container that is periodically emptied at an approved location.

Radiation Shielding. Temporary radiation shielding will be placed around the grout delivery arm where it enters into the tank riser. Concrete blocks and/or lead blankets will be the principal components used to provide the necessary temporary shielding. Further study will be necessary to determine the materials and thickness required for effective shielding.

Equipment Removal and Decontamination. When the 4 to 12-inch layer of wet grout has been poured on top of the solidified heel, the grout delivery arms will be removed and decontaminated as necessary. After removal and decontamination, the arms will be stored in a temporary shelter or relocated to the next tank scheduled for heel solidification.

The flange covers will then be placed on the risers and the concrete shield covers returned to their position on top of the risers. Void filling will be the next activity to take place in the tank.

C-3.1.20 Completion of Heel Stabilization

Once the equipment from the tank has been removed and decontaminated, the risers sealed, the temporary VOG system disconnected, and a HEPA filter installed, heel stabilization activities for the tank will have been completed.

Preparatory work for the next tank in sequence will begin during heel stabilization activities for the current tank. When equipment for the tank undergoing heel stabilization is no longer required at that tank, it will be relocated to the next tank in the closure sequence.

C-3.2 Heel Displacement With Grout Using Additional Waste Transfer Equipment—Scenario B

The main difference between this scenario and Scenario A is that extra effort will not be expended to remove residual wastes remaining in the tank. In Scenario A, the tank interior would be washed and the heel agitated. Tank washdown and heel agitation will not be performed in Scenario B.

As described in the overview, as much of the heel as possible will be removed with steam jets or air lifts, a submersible pump will be installed and more heel removed, then, while the heel is being grouted, the displaced heel will be further removed with the submersible pump. Dry grout will be dispersed to absorb any free liquids and then a final grout cover will be placed over the solidified heel.

This description begins with tank preparation activities and finishes with heel grouting. A detailed flow diagram showing the steps involved is presented in Figure C-3.

C-3.2.1 Tank Preparation

Before heel stabilization can occur, the tank must be prepared to accept equipment related to these activities.

Tank preparation steps for Scenario B are similar to the steps outlined in Scenario A. The main difference between the preparation steps for the two scenarios is that in Scenario B, the heel will be flushed with water to adjust the pH to a range of 0.5 – 2.0 before the tank risers are opened to remove and install equipment.

Other than adjusting the pH before opening the tank risers, tank preparation steps are the same for the two scenarios. Tank liquids will be removed with steam jets or air lifts, the heel will be characterized, a temporary VOG system will be installed, existing equipment will be removed from the tank risers, and video equipment and lighting will be installed inside the tank.

Refer to Scenario A for a description of tank preparation activities.

C-3.2.2 Heel Stabilization

Heel stabilization occurs in the same manner as Scenario A except that the heel will not be agitated.

C-3.2.3 Completion of Heel Stabilization

Once the equipment from the tank has been removed and decontaminated, the risers sealed, the temporary VOG system disconnected, and a HEPA filter installed, heel stabilization activities for the tank will have been completed.

Preparatory work for the next tank in sequence will begin during heel stabilization activities for the current tank. When equipment for the tank undergoing heel stabilization is no longer required at that tank, it will be relocated to the next tank in the closure sequence.

C-3.3 Heel Displacement With Grout Using Existing Equipment—Scenario C

The main difference between this scenario and Scenario B is that only the steam jets and airlifts are used to remove the heel displaced by the grout. The displaced heel would be removed with a submersible pump in Scenario A and B. Tank wash down and heel agitation are not be performed in Scenario C.

As described in the overview for Scenario C, as much of the heel as possible will be removed with steam jets or airlifts. The heel remaining in the tank will range in depth from 4 to 12 in. with a pH range of 0.5 – 2.0. A wet grout layer will be placed in the tank with a grout delivery arm. As the heel is being grouted and displaced, the steam jets or airlifts will remove as much of the heel as possible until the suction of the jet is plugged with wet grout.

Dry grout will be dispersed to absorb any remaining free liquids and then a final grout cover will be placed over the solidified heel.

This description begins with tank preparation activities and finishes with heel grouting. A detailed flow diagram showing the steps involved is presented in Figure C-5.

C-3.3.1 Tank Preparation

Before heel stabilization can occur, the tank must be prepared to accept equipment related to these activities.

Tank preparation steps for Scenario C are similar to the steps outlined in Scenario A. The main difference in the preparation steps for the two scenarios is that in Scenario C, the heel will be flushed with water to adjust the pH to a range of 0.5 – 2.0 before the tank risers are opened to remove and install equipment.

Other than adjusting the pH before opening the tank risers, tank preparation steps are the same for Scenarios A, B, and C. Tank liquids will be removed with steam jets or airlifts, the heel will be characterized, a temporary VOG system will be installed, existing equipment will be removed from the tank risers, and video equipment and lighting will be installed inside the tank.

Refer to D-1.3.1 "Scenario A" for a description of tank preparation activities.

C-3.3.2 Heel Stabilization

Heel stabilization occurs in the same manner as Scenario A except that the heel will not be agitated and a new removal pump will not be used.

A heel approximately 4 to 12 inches deep will remain in the tank with a pH between 0.5 and 2.0. Wet grout will be transported through a 2 to 4-inch pipeline to the delivery arm located in the tank's centermost riser. The depth of wet grout deposited in the tank floor will depend on the steam jet/airlift distance from the tank floor. As the steam jet/airlift distance from the floor increases, a deeper layer of grout will be required to ensure that the displaced heel will be removed by the steam jet/airlift. The minimum grout depth placed would be approximately 12 in. while the maximum grout depth would be approximately 18 in.

The maneuverable delivery arm will place grout where necessary to displace the remaining heel towards the steam jet or airlift. The steam jet/airlift will continue removing the displaced heel until the suction is plugged with grout. Any remaining heel liquids will be localized near the steam jet/airlift. The steam jet/airlift will be removed and a maneuverable dry grout delivery arm will be inserted into the same riser. Aided by the remote camera, the delivery arm will be maneuvered to disperse dry grout on the remaining free liquids. After the dry grout has been placed, the delivery arm will be removed and decontaminated.

C-3.3.3 Completion of Heel Stabilization

Once the equipment from the tank has been removed and decontaminated, the risers sealed, the temporary VOG system disconnected, and a HEPA filter installed, heel stabilization activities for the tank will have been completed.

Preparatory work for the next tank in sequence will begin during heel stabilization activities for the current tank. When equipment for the tank undergoing heel stabilization is no longer required at that tank, it will be relocated to the next tank in the closure sequence.

C-4. REFERENCES

C-1. *High-Level Waste Tank Farm Replacement Project – Existing Tank Flushing Special Study,* RPT-030; August 1993, ICF Kaiser Engineering.

C-2. EDF-TFC-031, *Flushing Calculations for Scenario A*, January 1998.

Appendix D

VOG System Details

CONTENTS

FIGURES

D-1. VOG SYSTEM DETAILS

This section provides detailed information on the temporary VOG System described in Section 8.2.3.6.2.

D-1.1 Filter Skid Description

The filter skids will contain a demister, superheater, and bag-in/bag-out HEPA filters. The demister function is to remove moisture from tank gases that would otherwise be collected in the HEPA filters. Operators will periodically drain demister condensate to the PEW system on a batch basis. The superheater will be located upstream of the HEPA filters and will function to increase the temperature of tank gases entering the HEPA filters by -7°C (20°F). This will ensure that the tank gases are above the dew point and prevent condensation within the HEPA filters and downstream piping. HEPA filters will remove airborne radioactive particles from the tank gases before release at the stack.

The filter skid units will be housed in prefabricated, insulated enclosures. The enclosures will have lighting, heating, ventilation, and lockable doors. Shielding, as required, will be incorporated into the fabrication of the filter skids.

D-1.2 Piping Description

The shielded condensate and VOG piping between the tanks, filter skids, and Process Equipment Waste (PEW) drain system will be 304L stainless steel and double contained. Unshielded piping exiting the HEPA filters and connecting to the temporary VOG system blowers will be made of 304L stainless steel and located abovegrade. The main exhaust line that connects from the temporary VOG system blowers to the existing stack will also be 304L stainless steel and located above grade.

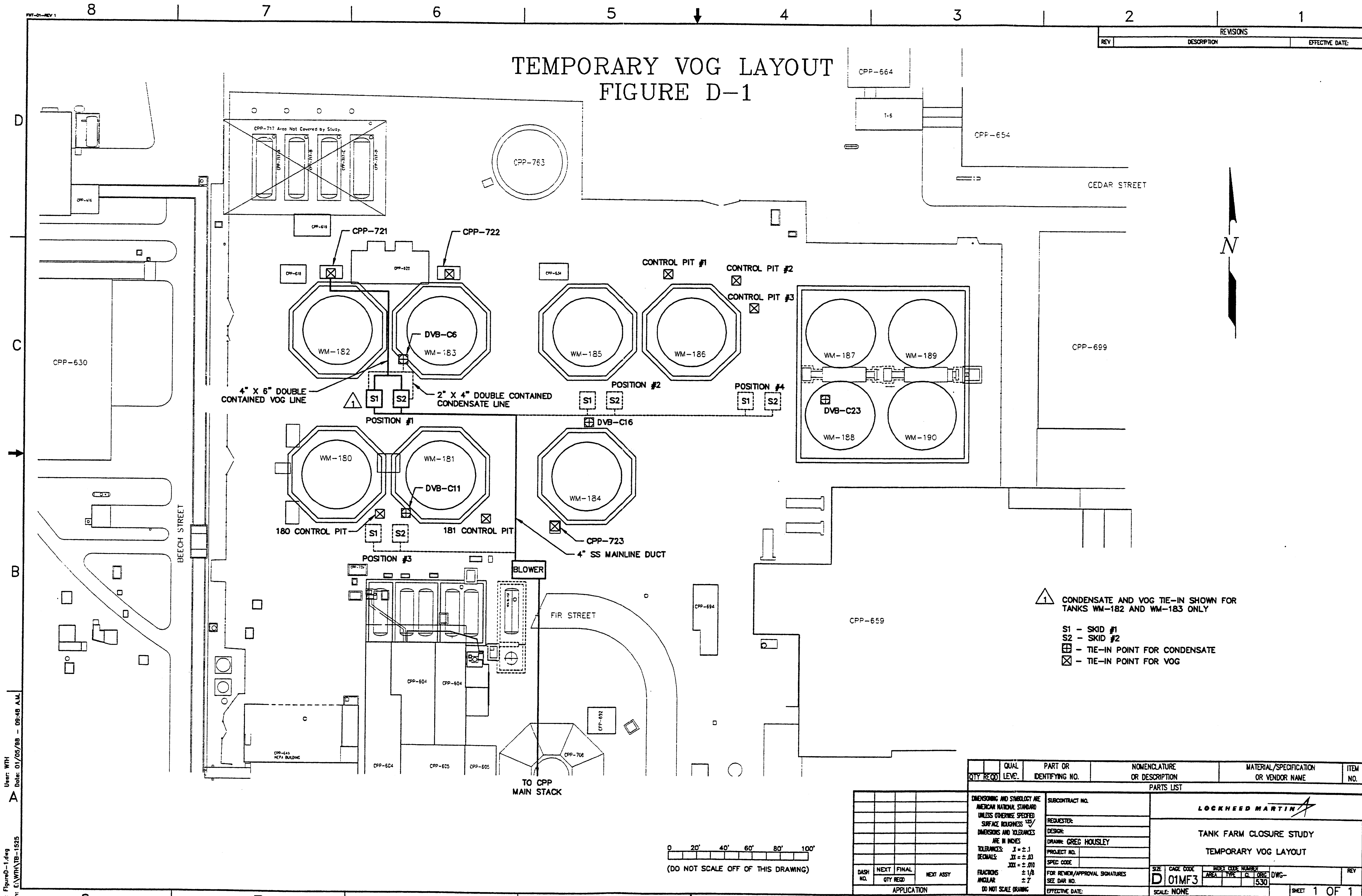
The main exhaust line will have "tees" located in various positions for temporary the filter skid tie-ins. Preliminary VOG system sizing calculations[D-1] estimate 4-inch lines between the filter skids and the "tees" on the main exhaust line. The main exhaust line will be a 6-inch line that feeds into the blowers and stack. The main exhaust line will run abovegrade from the blowers to the CPP-708 stack. This pipe will tie into an existing 6-inch line (6 inch-VG-AR-108962) near the stack penetration.

The maximum flow rate within the piping will be 80 acfm using two 1-Hp motors with 13 inch of static pressure. The double-contained condensate lines between the filter skid and the PEW tie-in will have a 1-inch inner pipe diameter and a 3-inch outer pipe diameter.

See Figure D-1 for the VOG tie-in points.

D-1.3 Instrumentation

Instrumentation at the filter skid will measure differential pressure across the HEPA filters. A high differential pressure across the HEPA filters will sound an alarm in the control trailers. The filter skids will also contain radiation monitors and alarms. The superheater will be temperature controlled, and the demister will have a level indicator and high-level alarm. located in the control trailers. A variable speed controller will allow the VOG blower speed to be easily varied for increased airflow into the risers when equipment is being removed or installed.



TEMPORARY VOG LAYOUT
FIGURE D-1

D-1.3.1 Installation

The temporary VOG system will be connected to the tank undergoing closure by installing a tee in the VOG line between the tank and relief valve. Piping from the VOG filter skid will be attached to the open end of the tee. Existing VOG piping within the relief pits will then be cut and capped to isolate the tank from the existing VOG system. Condensate drain lines from the demisters will be connected to the PEW system by cutting lines in associated valve boxes and pits and installing tees. After the piping connections are made, the temporary VOG system may begin operation.

D-1.3.2 Relocation

The temporary VOG system will be disconnected after tank closure activities requiring system are completed. The pressure/vacuum relief valve will be removed and a blind flange installed to prevent the possibility of a clean tank becoming contaminated through the pressure relief line. The tank VOG line will be fitted with a passive HEPA filter to prevent the release of any remaining contaminants within the tanks. The temporary VOG system will then be prepared for relocation.

The bag-in, bag-out HEPA filter will be removed and the system flushed as necessary. The flushed waste will be transferred to the PEW system via the filter skid drain line. A new HEPA filter will be installed in the unit before the filter skid is moved. Contaminated HEPA filters will be bagged and boxed for disposal at the CPP-659 decontamination cell. Once this stage is reached, piping will be disconnected from the skid and the skid will be relocated to the next scheduled tank.

Temporary VOG filter skid placement will be based primarily on weight restrictions. The filter skid will be lifted by crane and placed in the next location. Filter skid locations will be as close to the tanks as is structurally acceptable to reduce the length of shielded double-contained piping that runs from the filter skid to the tie-in point.

The filter skids will be positioned in Zone C areas approximately 10 feet from the outer perimeter of the tank, reducing unnecessary weight directly above the tanks. Piping for the temporary VOG system may be placed directly in Zone A and B to reduce the overall pipe run lengths.

D-1.3.3 Radiation Shielding

Shielding will be required for the temporary piping between the tank and HEPA filters. This piping section could receive contamination from tank gases entering the filter skid. Shielding can be accomplished by a number of methods including, but not limited to: (a) covering the piping with soil, (b) placing concrete slabs over the piping, and (c) placing lead blankets over the piping. Controls (that is, shielding) are required by ALARA standards for systems that emit radiation at levels greater than 5 mrem/hr.

D-1.3.4 Equipment Decontamination

Secondary piping and filter skid units would be designed to facilitate decontamination. Waste solution generated during equipment decontamination could be sent to the PEW evaporator (PEWE) for waste reduction. The double-contained piping will be decontaminated before being relocated to the next tank. The single-walled piping downstream of the HEPA filters will not require decontamination since the upstream HEPA filters will remove the airborne waste contained in the tank gases.

D-2. VOG TIE-IN POINTS

Tie-in points have been developed to allow connection of the temporary VOG system to the tank being closed.

D-2.1 Existing VOG System

Piping tees will be added to the existing VOG system to allow easy access of the new supplemental VOG system to the tanks. These tees will be added in pits that are accessible from the surface; thus no excavation is required. Tee locations include:

WM-180 Tee addition to 8 inch PWM-18038 in the relief valve pit between PSV-WM-137 and the wall.

WM-181 Tee addition to 8 inch PWM-181340 in the relief valve pit between PSV-WM-135 and the wall.

WM-182 Tee addition to 10" VGA-603 in CPP-721 between PSV-WM-83 and the wall.

WM-183 Same as WM-182.

WM-184 Tee addition to 10 inch VGN-605 in CPP-723 between the wall and the connection to 10 inch VGA-605.

WM-185 Tee addition to 10 inch VGA-1002 in CPP-722 between WM-383 and the wall.

WM-186 Tee addition to 10 inch VGN-1001 in Control Pit No. 1 between wall and connection to 4" VGA-1001.

WM-187 Tee addition to 10 inch VGA-1202 in Control Pit No. 2 between PSV-WM-108 and the wall.

WM-188 Tee addition to 10 inch VGA-1201 in Control Pit No. 2 between PSV-WM-109 and the wall.

WM-189 Tee addition to 10 inch VGA-1301 in Control Pit No. 3 between PSV-WM-208 and the wall.

WM-190 Tee addition to 10" VGA-1201 in Control Pit No. 3 between PSV-WM-209 and the wall.

D-2.2 PEW System

Tie-ins for the VOG system to the PEW drain system can be made at the following locations:

WM-180 Tie-into 1-1/2 inch PLA-104705 in DVB-WM-PW-C11 between tee with 1-1/4 inch PLA-104704 and DVB wall.

WM-181 Tie-into 1-1/2 inch PLA-104705 in DVB-WM-PW-C11 between tee with 1 ¼ inch PLA-104704 and DVB wall.

WM-182 Tie-into 1-½ inch PLA-104710 in DVB-WM-PW-C6 between tee and DVB wall. [different from Kaiser recommendation]

WM-183 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C6 between tee and DVB wall. [different from Kaiser recommendation]

WM-184 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C16 between tee with 1-1/4 inch PLA-104706 and the DVB wall.

WM-185 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C16 between tee with 1-1/4 inch PLA-104706 and the DVB wall.

WM-186 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C16 between tee with 1-1/4 inch PLA-104706 and the DVB wall.

WM-187 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C23 between tee with 1-1/4 inch PLA-104711 and DVB wall.

WM-188 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C23 between tee with 1-1/4 inch PLA-104711 and DVB wall.

WM-189 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C23 between tee with 1-1/4 inch PLA-104711 and DVB wall.

WM-190 Tie-into 1-1/2 inch PLA-104710 in DVB-WM-PW-C23 between tee with 1-1/4 inch PLA-104711 and DVB wall.

D-3. REFERENCES

D-1. High-Level Waste Tank Farm Replacement Project – Existing Tank Flushing Special Study. RPT-030; August 1993. ICF Kaiser Engineering.

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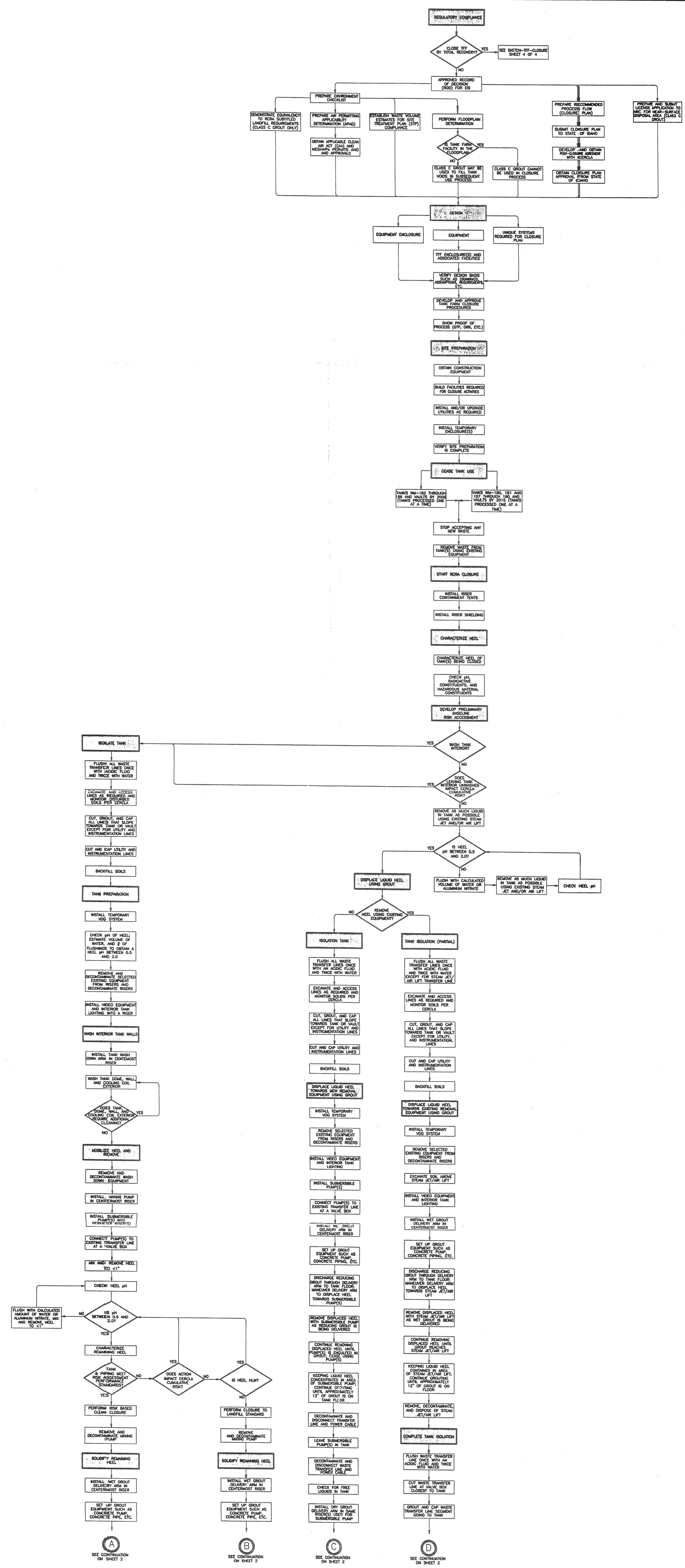

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FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE E · CAGE CODE 01MF3 · INDEX CODE NUMBER AREA / TYPE / CL / ORIG 530 · DWG- · REV
EFFECTIVE DATE:	SCALE: NONE · SHEET 1 OF 4

REV	DESCRIPTION	EFFECTIVE DATE:
	REVISIONS	

REVISIONS		
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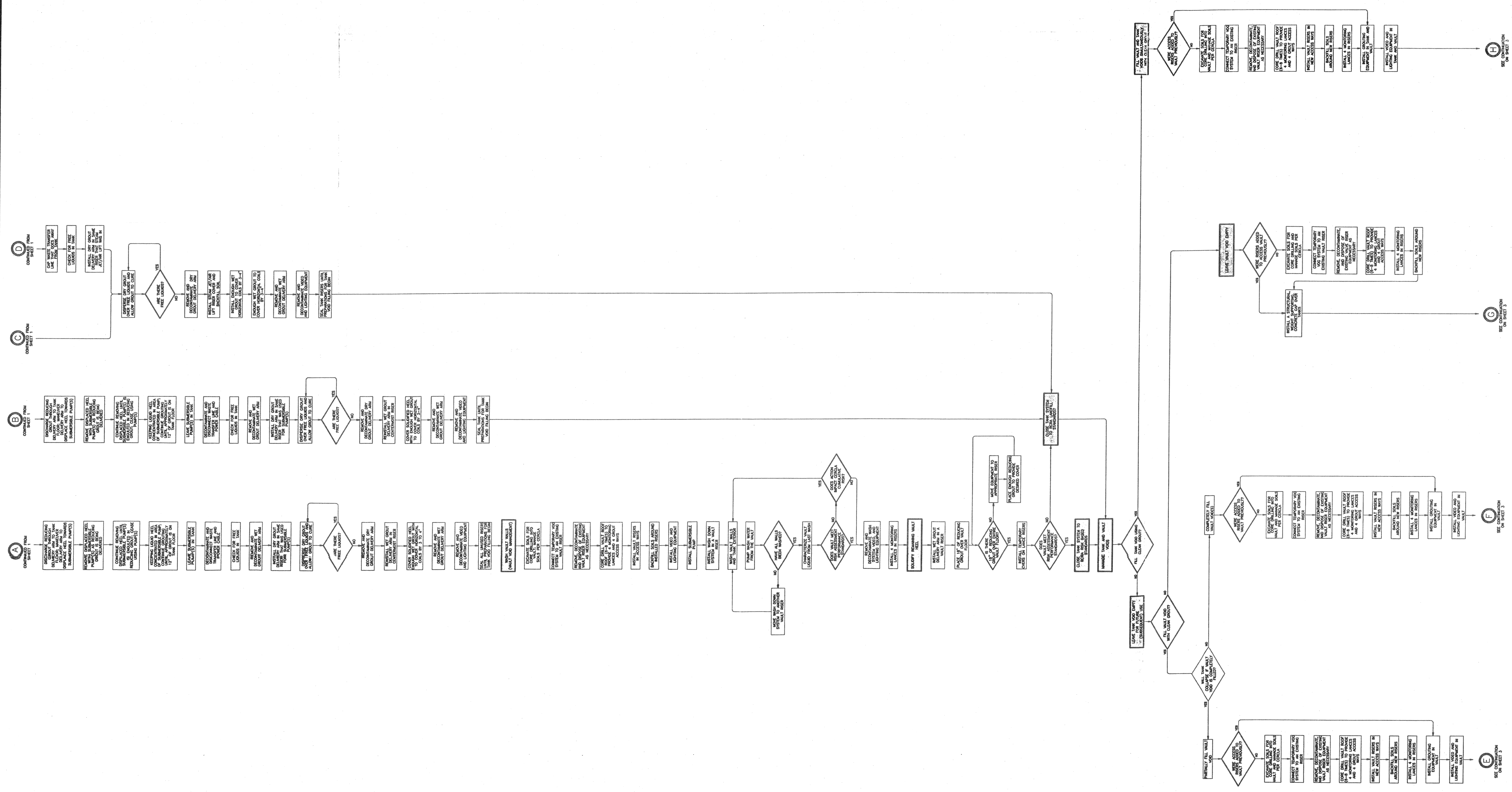

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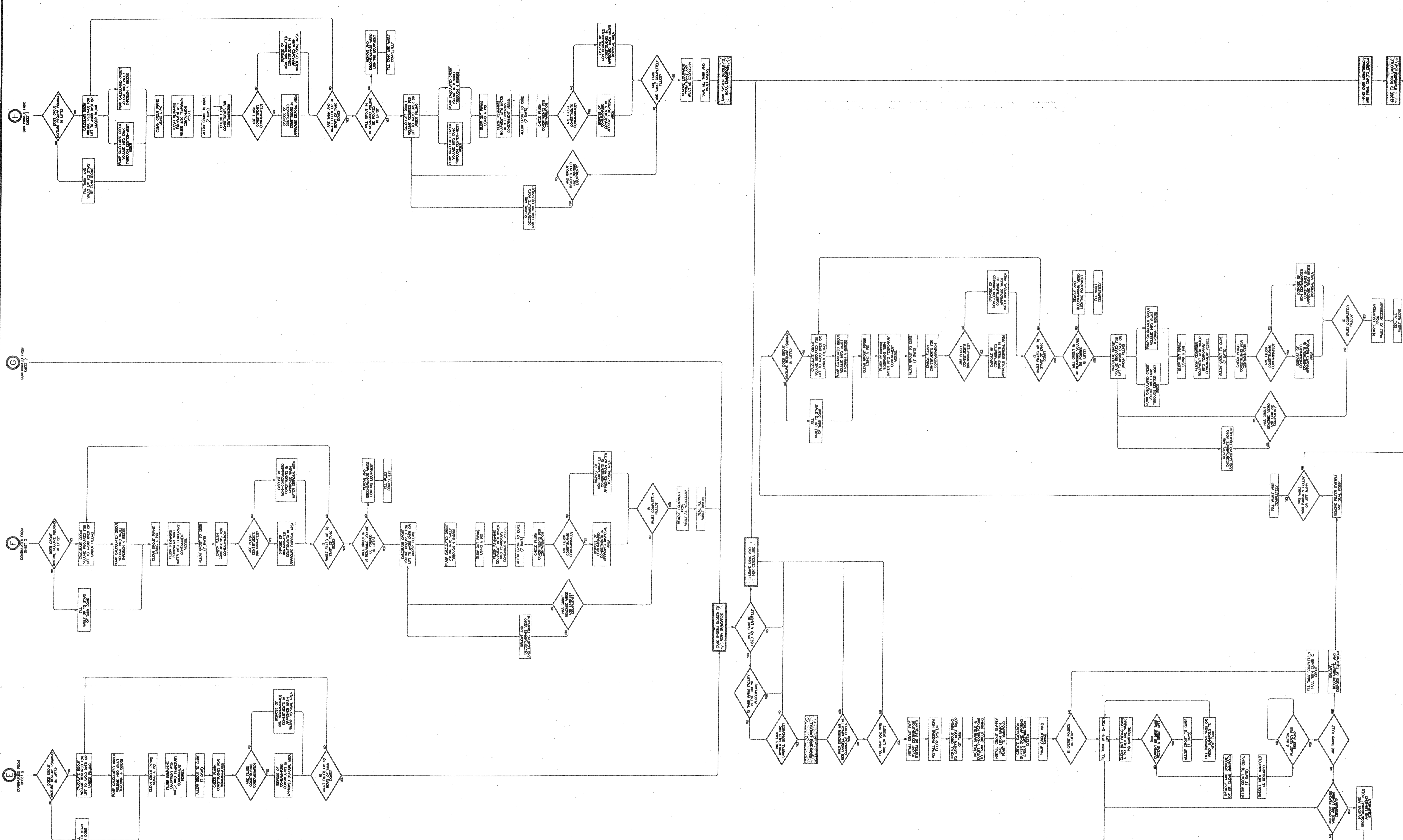

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DRAWN:	
PROJECT NO.	
SPEC CODE	
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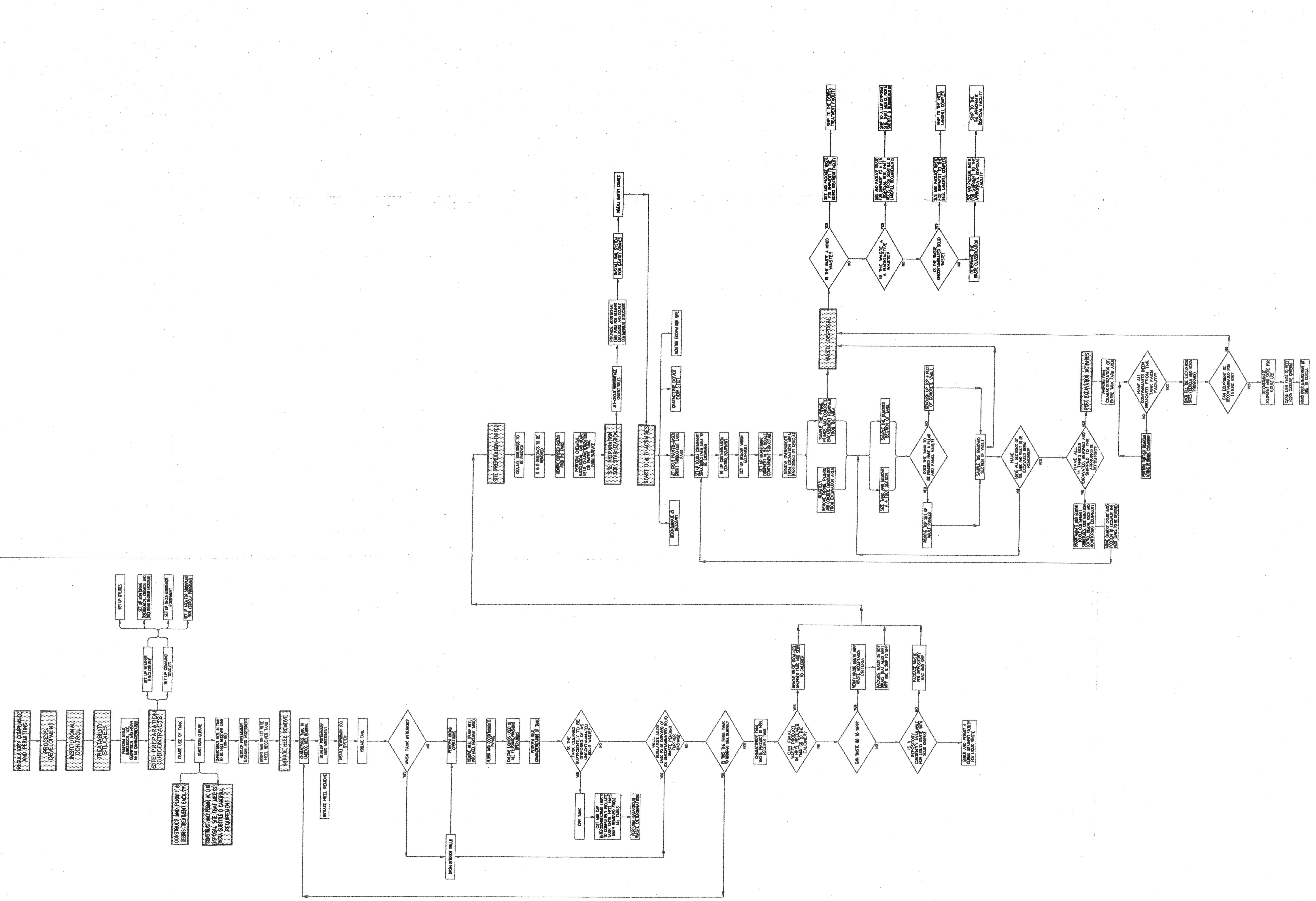

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FOR REVIEW/APPROVAL SIGNATURES
SEE DAR NO.
EFFECTIVE DATE:

LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
PROCESS FLOW SKETCH

SIZE E | CAGE CODE 01MF3 | INDEX CODE NUMBER 530 | DWG- | REV
SCALE: NONE | SHEET 4 OF 4

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